

KYOTO UNIVERSITY

**PUBLICATIONS
OF THE SETO MARINE
BIOLOGICAL LABORATORY**

Vol. II, No. 2.

(Article 3 to 22)

**Jubilee Number
for the
Thirtieth Anniversary of the Foundation
of the Laboratory**

**SIRAHAMA, WAKAYAMA-KEN, JAPAN
PUBLISHED BY THE LABORATORY**

October 1952

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THE SETO MARINE BIOLOGICAL LABORATORY OF KYOTO UNIVERSITY*

DENZABURO MIYADI (Director)

and

HUZIO UTINOMI (Superintendent)

With Plates II-V

HISTORICAL SKETCH

- 1922 Laboratory established at the village of Seto-kanayama (Sirahama Town now named), Wakayama Prefecture. Whole buildings completed in spring and actual activities began in summer (July 28) under the directorship of Prof. T. KAWAMURA.
- 1923 Prof. T. KOMAI elected Administrator of the Laboratory.
- 1929 His Majesty the Emperor visited the Laboratory on the way of his journey to Kansai districts.
Aquarium attached to the Laboratory began to open to the public and then enlarged.
- 1934 Prof. YŌ K. OKADA elected Administrator of the Laboratory.
- 1935 Research ship the "Nyūsin-maru" sold and a new motor boat the "Pelagia" arrived.
- 1937 Prof. T. KOMAI elected again Administrator of the Laboratory the name of which was henceforth altered to Director by the reform of government organization.
- 1944 Amalgamation of the Memorial Museum of Natural History at Seto-kanayama with the Laboratory. The former was rebuilt after removal to the site of the Laboratory.
- 1946 Prof. D. MIYADI elected Director of the Laboratory.
Many of laboratory buildings and their equipments damaged by great earthquake shock on December 21th.

* Contributions from the Seto Marine Biological Laboratory, No. 175.

1948 Research laboratory and aquarium buildings rebuilt.

1951 Students' laboratory renovated.

STAFF

PRESENT PERSONNEL

Scientific Staff

Director (*Part-time*): Prof. Denzaburo MIYADI, M.Sc., D.Sc., M.J.S.C. (*Ecologist*)

Superintendent: Huzio UTINOMI, M. Sc., D. Sc. (*Zoologist*)

Scientific Officers: Takasi TOKIOKA, M. Sc., D. Sc. (*Zoologist and planktologist*)

Isamu YAMAZI, M. Sc. (*Hydrologist and planktologist*)

(*Non-resident*) Tokubei KURODA, D. Sc. (*Malacologist*)

(*Part-time*) Tadashige HABE, M. Sc. (*Malacologist and ecologist*)

Laboratory Staff

Skipper and Collector (*Temporary*): Yanosuke SAKAI.

Engineer and Collector: Syûzi URA and Syôzô SAKAI.

Laboratory assistant (*Part-time*): Torao YAMAMOTO.

Typist and Clerical assistant: Miss Yoshiko MORI.

Janitor and Cook: Toyomatu TUZI.

Housekeeper: Mrs. Kikue TUZI.

Other 3 temporarily appointed aquarium attendants.

FORMER PERSONNEL

Director

Tamiji KAWAMURA, Prof., M. Sc. (*Rector of Pref. University of Siga, Hikone*) 1922-23

Taku KOMAI, Prof., D. Sc., M.J.A. (*Chief member of National Institute of Genetics, Misima*) 1923-33, 1937-46

Yô K. OKADA, Prof., M. Sc., D. Sc., M.J.A. (*Formerly Dean of Science Faculty, Tokyo University, Tokyo*) 1933-37

Scientific Staff

Jiro IKARI* (*Deceased in July 1937*) 1922-31

Kôzô AKATSUKA (*Lecturer of Prefectural University of Mie, Tu*) 1922-33

Iwao TAKI, M. Sc., D. Sc. (*Professor of Hiroshima University, Mukaizima*) 1928-31

- Hisao SUGINO, M. Sc. (*Professor of Osaka University of Liberal Arts, Osaka*) 1931
 Sueo M. SHIINO, M. Sc., D. Sc. (*Professor of Prefectural University of Mie, Tu*) 1931-36, 1941
 Yoshinobu MIYASHITA,* M. Sc. (*Deceased in July 1942*) 1932-35
 Yasuhiro TOKUOKA (*Researcher of Nihon Yusi K.K. Research Institute, Kawasaki*) 1934-38
 Kiyoshi HIRABAYASHI, M. Sc., D. E. (*Ass't professor of Institute of Chemical Research, Kyoto University, Takatuki*) 1934-38
 Denzaburo MIYADI, M. Sc., D. Sc. (*Professor of Kyoto University, Kyoto*) 1936-42
 Kanefumi NOZAWA,* M. Sc., D. Sc. (*Deceased in February 1946*) 1939-41, 1942-46
 Tetsuo MASUI* (*Deceased in October 1942*) 1940-42
 Sôichirô SAKAGUCHI (*Wakayama*) 1942-46
 Nobuyuki TAKEDA, M. Sc., D. Sc. (*Formerly Professor of Prep. Department of Syowa Medical College, Tokyo*) 1942, 1944-47
 Miss Chiyoko KASUYA (Mrs. N. TAKEDA) 1943-47
 Yoshiichi MATSUI, D. Ag. (*Director of Nippon Institute for Scientific Research on Pearl, Kyoto*) 1946-48
 Miss Miho IKARI (*Teacher of Hatiman High School, Hatiman*) 1947-50
 * Deceased

LOCATION

The Laboratory is located on a little peninsula on the west coast of Kii Province, about 40 miles northwest of Sio-no-misaki, the southernmost promontory of the main island of Japan and about 80 miles south of Osaka. The site is formerly named Seto-kanayama as village and now Sirahama Town since 1940. The town is well known as a hot-spring place with beautiful landscape and natural monuments, and many tourists at home and abroad visit for sight-seeing and taking a bath.

In addition, the marine life in the environs, littoral as well as pelagic, is characterized by its tropical faces and also by the richness and diversity in forms. This is due to the influence of a northerly branch of the "Kurosio" current washing along the west coast of Kii Peninsula, and also to the profuse indentations of the sea floor. The location of the Laboratory furnishes naturalists with excellent working grounds and is thus available as a base for wide-range field work involving both the terrestrial and marine biology in southern Honsyu.

During the thirty years since its establishment, various improvements have been made, and the Laboratory is now becoming one of the centers for the promotion of marine science in Japan.

EQUIPMENT AND FACILITIES

The area belonging to the Laboratory covers about 33,680 sq. m. on the tombolo hemmed in between the sea on the north and south. The Laboratory as a whole consists of ten separate buildings. They are all flat wooden houses, except only the museum being of two-stored.

Research laboratory	1 (303 sq.m.)
Special research laboratory	1 (168 sq.m.)
Students' laboratory	1 (224 sq.m.)
Aquarium	1 (407 sq.m.)
Museum	1 (218+204 sq. m.)
Dormitories	2 (302 sq.m., 173 sq.m.)
Official residences	3 (221 sq.m.)

The main laboratory contains twelve rooms of concrete floor: an office, library, instrument-working room, storage room, photographic dark room, physiological room, chemical room, oceanographical room and three individual research rooms, seven of which are supplied with running fresh and salt water fittings, and a wide cement sink, and also with electric light and power (3-phase, 110/220 volts, 60 cycle). Equipments for general biological and hydrological researches are mostly available. For collecting material and work on the sea there are at present two vessels, one called the "*Jan'hina II*" of 3 tons capacity, equipped with a 7.5 h.p. Diesel gas engine and a row boat called the "*Obelia*".

Besides these, the Laboratory has now been equipped with improved facilities for regular meteorological observations.

The Laboratory was established primarily to provide facilities for research in marine biology and also to give students in that university laboratory courses in marine biology. Since the war, however, the Laboratory has been opened for a course in marine biology and elementary oceanography to undergraduate students in other universities or colleges and to teachers of biology in public schools of lower grade, mainly from April to August. During the spring and summer vacations of every year, the Laboratory is crowded with many enthusiastic students.

The course is regularly conducted by members of the laboratory staff and by teachers of other schools attended. Usually it consists of lectures, laboratory exercises, field works, collecting trips and discussions. During the course some pamphlets for guide to exercises printed by the Laboratory are freely used. Since the war, students and teachers attended to these courses have successively been increased year after year, as follows.

	Schools or parties	Days	Attendants
1946	6	20	72
1947	8	36	103
1948	18	67	196
1949	19	80	397
1950	13	62	312
1951	23	90	370

Besides, the following is the number of visitors working at the Laboratory in recent years since the war.

1946	14	1949	17
1947	15	1950	25
1948	14	1951	36

Research work by members of the laboratory staff has been proceeding actively. In other respects also the Laboratory offers special facilities for instruction in marine science, and thus promotes for the advancement of marine research in our country.

LIBRARY

The Library contains many of the important marine biological journals, several thousand reprints and about 2000 bound volumes. The reports of expeditions, monographs and other books not found in the Library have temporarily been borrowed from the Zoological Institute of Kyoto University at Kyoto. The recent valuable additions to the Library include a complete set of algological and planktological books and reprints belonging to the late Jiro IKARI, one of the founders of the Laboratory. The Library has lately been much used by visiting workers or students in other universities.

The number of periodicals or reprints of papers being regularly received by the Library has been appreciably increased during recent years by gifts or exchanges. Thanks of the Laboratory are due to many Departments or Institutions at home and abroad for their gifts and courtesies presented to the Library. The following is a list of the periodicals and publications received since the end of War II. Subtitles of journals and reports in Japanese are given in the original form as well as in explanatory English translation if no accepted translation could be found.

AUSTRALIA

- ✓ *Australian Jour. Mar. and Freshw. Research*, Melbourne.
Bulletin C.S.I.R.O., Melbourne.

Memoirs Queensland Museum, Brisbane.
Technical Paper C.S.I.R.O., Melbourne.

BELGIUM

Bull. Inst. Royal Sci. Nat. Belgique, Bruxelles.
Inst. Zool. Ed. Van Beneden, Liège. (Travaux)

BERMUDA

Bermuda Biol. Stat. Res., Bermuda. (Contributions)

CANADA

Annual Report, Fish. Board of Canada, Ottawa.
Bull. Fish. Res. Board of Canada, Ottawa.
Jour. Fish. Res. Board of Canada, Ottawa.
Rapport Annuel, Stat. Biol. St-Laurent, Québec.
Stat. Biol. St-Laurant, Québec. (Contributions)

CEYLON

Fish. Res. Station, Colombo. (Reprints)

CHINA

Amoy Fisheries Bulletin, Amoy.

DENMARK

Report Danish Biol Stat., Charlottenlund.

EGYPT

Publications Mar. Biol. Stat., Gardafa.

FINLAND

Annales Bot. Soc. Fennicae "Vanamo", Helsinki.
Annales Zool. Soc. Fennicae "Vanamo", Helsinki.
Archivum Soc. Zool. Bot. Fennica "Vanamo", Helsinki.
Zool. Station, Tvärminne. (Contributions)

FRANCE

Bull. Inst. Océanogr., Monaco.
Bull. Lab. Marit., Dinard.
Bull. Mus. Nation. Hist. Nat., Paris.
Bull. Stat. Biol., Arcachon.
Stat. Biol., Roscoff. (Travaux et ses Supplément)
Stat. Mar. Endoume, Marseille. (Travaux)
Stat. Zool., Villefranche-sur-Mer. (Travaux)
Unesco Bulletin for Libraries, Paris.
Vie et Milieu/Bull. Lab. Arago, Banyuls-sur-Mer.

FRENCH WEST AFRICA

Bull. Inst. Français d'Afrique Noire, Dakar.
Bull. Soc. Sci. Nat. Maroc, Rabat.

Comptes Rendus Séances Mens., Séance Hydrogéol., Rabat.
Initiations Africaines, Dakar.
Mém. Inst. Français d'Afrique Noire, Dakar.
Mém. Soc. Sci. Nat. Maroc., Rabat.
Travaux Inst. Sci. Cherifien, Rabat.

GERMANY

Helgoländer Wissenschaftliche Meeresuntersuchungen, List auf Sylt.
Kieler Meeresforschungen, Kiel.
Kurze Mitteilungen Fischereibiologie, Abt., Max Planck-Inst. Meeresbiol., Wilhelmshaven.
Senckenberg am Meer, Wilhelmshaven.
Veröffentlichungen Inst. Meeresforschung, Bremerhaven.

GREAT BRITAIN

Annual Report Scottish Marine Biol. Assoc., Millport.
Bibliographical Series, Science Library, London.
Dept. Zool., Univ. Coll., Hull. (Reprints)
Dept. Zool., Univ. of Cambridge, Cambridge. (Reprints)
Dept. Zool., Univ. of Edinburgh, Edinburgh. (Reprints)
Dept. Zool., Univ. of Manchester., Manchester. (Reprints)
Fishery Investigations, Min. Agr. & Fish., Series I & II, London.
Hull Bulletins of Marine Ecology, Hull.
Jour. Mar. Biol. Assoc. United Kingdom, Plymouth.
Report, Dove Marine Lab., Cullercoats, Newcastle.
Report on Fisheries of Scotland, Scottish Home Dept., Edinburgh.
Sci. Invest., Scottish Home Dept., Edinburgh.
Scottish Mar. Biol. Assoc., Millport. (Collected Reprints)
Scottish Sea Fisheries Statistical Tables, Scottish Home Dept., Edinburgh.
Statistical Tables, Sea Fisheries, Min. Agr. & Fish., London.

HOLLAND

Amsterdam Naturalist, Amsterdam.
Beaufortia, Zool. Mus., Amsterdam.
Zoologische Mededelingen, Leiden.
Zoologische Verhandelingen, Leiden.

INDIA

Bull. Madras Government Mus., Nat. Hist. Section, Madras.
Freshwater Biol. Stat. Madras Fisheries, Madras. (Reprints)
Records Indian Mus./Jour. Ind. Zool., Calcutta.

INDOCHINA

Inst. Oceanogr. Indochine, Nhatrang. (Contributions)
Mém. Inst. Océanogr. Indochine, Nhatrang.
Notes Inst. Océanogr. Indochine, Nhatrang.

INDONESIA

Treubia, Bogor.

ITALY

- Bibliographia Oceanographica*, Roma-Venezia.
Bollettino Pesca Piscicolt. Idrobiol., Roma.
Nova Thalassia, Venezia.
Pubbl. Ist. Zool. Anat. Comp., Padova. (Collected Reprints)
Pubbl. Staz. Zool., Naples.

JAPAN

- Akkeshi Mar. Biol. Stat.*, *Hokkaido Univ.*, Akkesi. (Contributions)
 'Animals and Zoo' (どうぶつと動物園), Tokyo.
Annual Report Central Fish. Exper. Stat. (水産試験場年報), Tokyo.
Annual Report National Inst. Genetics (國立遺傳學研究所年報), Misima.
Biol. Jour. Okayama Univ., Okayama.
Bull. Biogeogr. Soc. Japan (日本生物地理學會々報), Tokyo.
Bull. Fac. Fish. Hokkaido Univ. (北海道大學水產學部研究彙報), Hakodate.
Bull. Fish. Exper. Stat. Hyogo-Ken (兵庫縣水產試驗場試驗報告), Akasi.
Bull. Inst. Chem. Res. Kyoto Univ. (京都大學化學研究所報告), Takatuki.
Bull. Japan Sea Regional Fish. Res. Lab. (日本海區水產研究所研究報告), Nanao.
Bull. Kobe Marine Observatory (神戸海洋氣象台彙報), Kobe.
Bull. Maizuru Marine Observatory (舞鶴海洋氣象台要報), Maizuru.
Bull. Mar. Biol. Stat. (海洋生物時報), Asamusi.
Bull. Nagasaki Marine Observatory (長崎海洋時報), Nagasaki.
Bull. National (or Tokyo) Science Museum (國立科學博物館研究報告), Tokyo.
Bull. Tokai Regional Fish. Res. Lab. (東海區水產研究所研究報告), Tokyo.
Bull. Tokyo Inst. Technology, Ser. A & B, Tokyo.
 'Business Rep. Fish. Res. Lab.' (水產研究所事業報告), Fish. Agency, Tokyo.
Central Fish. Exper. Stat., Tokyo. (Contributions)
Ecological Review (生態學研究), Sendai.
Fish. Lab. Fac. Agr., Tokyo Univ., Sinmaiko-Ikawazu (Contributions)
Fisheries Statistical Bulletin (水產統計資料), Fish. Agency, Tokyo.
Icones Marine Animals & Plants in Hokkaido (北海道海產動植物圖譜), Yoiti.
Illust. Catalogue of Japanese Shells (日本貝類圖錄), Kyoto.
Jap. Jour. Ichthyology (魚類學雜誌), Tokyo.
Jour. Dept. Agr. Kyushu Univ., Hukuoka.
Jour. Fac. Fish. Pref. Univ. of Mie (三重縣立大學水產學部紀要), Tu.
Jour. Fisheries (水產學雜誌), Hakodate.
Jour. Fish. Res. Inst. (水產研究會報), Tokyo.
Jour. Hokkaido Fish. Exper. Stat. (北水試月報), Yoiti.
Jour. Inst. Polytechnics, Osaka City Univ., Ser. D. Biol., Osaka.
Jour. Inst. Res. Sci. Fish., Hakodate Coll. Fish. (水產科學研究所報告), Hakodate.
Jour. Kagoshima Fish. Coll. (鹿児島水產專門學校研究報告), Kagosima.
Jour. Oceanogr. Soc. Japan. (日本海洋學會誌), Tokyo.
Jour. Oceanogr., Kobe Mar. Observ. (神戸海洋時報), Kobe.
Jour. Oceanogr., Maizuru Mar. Observ. (舞鶴海洋時報), Maizuru.
Jour. Sci. Hirosima Univ., Ser. B, Divs. 1 & 2, Hirosima.
Jour. Shimonoseki Coll. Fish. (第二水產講習所研究報告), Shimonoseki.
Jour. Tokyo Univ. Fish. (東京水產大學研究報告), Yokosuka.

- Jour. Wakayama Fish. Sci. Inst.* (和歌山縣水産試験場事業月報), Tanabe.
Mem. Coll. Agr. Kyoto Univ., Fisheries Series, Kyoto.
Mem. Coll. Sci. Univ. Kyoto, Ser. A & B, Kyoto.
Mem. Kobe Mar. Observ., Kobe.
Misc. Rep. National Sci. Mus. (國立科學博物館集報), Tokyo.
Misc. Rep. Res. Inst. Nat. Res. (資源科學研究所彙報), Tokyo.
Museum Studies (博物館研究), Tokyo.
'Monthly Rep. Oceanogr. Cond. Japan Sea' (裏日本海況月報), Maizuru.
Nanki Seibutsu and its Supplement (南紀生物), Sirahama.
Natural Science and Museums (自然科學と博物館), Tokyo.
Oceanographical Chart (海洋圖), Tokyo.
Oceanographical Data (海況速報), Maizuru.
Oceanographical Reports (海洋報告—海洋時報), Maizuru.
Oceanography and Meteorology (海象と氣象), Nagasaki.
Physiology and Ecology (生理生態), Kyoto.
Proc. Japan Acad., Tokyo.
Publ. Akkeshi Mar. Biol. Stat., Akkeshi.
Reports and Preliminary Study, Natural Resources Section, SCAP, Tokyo.
Rep. Inland Sea Fish. Co-operative Invest., Naikai Regional Fish. Res. Lab. (瀬戸
 内海水産連絡調査要報), Hiroshima.
Rep. Inst. Agr. Res., Tohoku Univ., Sendai.
Rep. Fac. Fish. Pref. Univ. of Mie, Tu.
'Rep. Jap. Assoc. Museums' (日本博物館協會々報), Tokyo.
Rep. Kôchi Univ., Nat. Sci. (高知大學研究報告), Kôchi.
Rep. Nagasaki Mar. Observ. (長崎海洋气象台報告), Nagasaki.
'Rep. Physiol. & Ecol., Coll. Sci., Kyoto Univ.' (京都大學理學部生理生態學研究業
 績), Kyoto.
Rep. Plankton (浮游生物速報), *Mar. Observ.*, Kobe.
'Res. Rep. Benthic Fish Resources' (底魚資源調查要報), Tokyo-Nanao.
'Res. Rep. Productivity of Inland Sea' (生産力調査要報), Tokyo.
'Res. Rep. Resources of Skipjacks and Tunas' (カツオ、マグロ資源調査要報), Tokyo.
Science of the Sea (海洋の科學), Tokyo.
Sci. Bull. Fac. Agr. Kyushu Univ. (九州大學農學部學藝雜誌), Hukuoka.
Sci. Pap. Hokkaido Fish. Sci. Inst. (北海道區水産研究所研究報告), Yoiti.
Sci. Pap. Inst. Algolog. Res., Hokkaido Univ., Muroran.
Sci. Rep. Saitama Univ., Ser. B, Urawa.
Sci. Rep. Tohoku Univ., Fourth Ser. (Biol.), Sendai.
Semi-annual Rep. Oceanogr. Invest. (海洋調查要報), Tokyo.
Shimoda Mar. Biol. Stat., Tokyo Bunrika Daigaku, Simoda. (Contributions)
Tohoku Jour. Agr. Res., Tohoku Univ., Sendai.
Venus/Jap. Jour. Malac. (ヴェキナス:貝類學雜誌), Mukaisima.

JUGOSLAVIA

- Acta Adriatica*, Split.
Notes Inst. Ocean. Ribarstvo, Split.
Rep. Inst. Ocean. Ribarstvo, Split.

NEW ZEALAND

Bulletin Auckland Inst. and Mus., Auckland.
Records Auckland Inst. and Mus., Auckland.
Report on Fisheries, Marine Department, Wellington.

NORWAY

Fiskeridirektoratets Skrifter, Ser. Havundersökelse, Bergen.
Hvalradets Skrifter, Oslo.
Tromsø Musems Årshefter, Tromsø.
Univ. i Bergen Årbok, Naturvitenskapelig Rekke, Bergen.
Univ. i Bergen Årsberetning, Bergen.

PORTUGAL

Travaux Stat. Biol. Maritime, Lisboa.

SOUTH AFRICA

Annual Report, Division of Fisheries, Sea Point.
Investigational Report, Fish. Mar. Biol. Surv. Div., Sea Point.

SPAIN

Boletín Inst. Español Oceanografía, Madrid.
Trabajos, Inst. Español Oceanografía, Madrid.

SWEDEN

Arkiv för Zoologi, Stockholm.
Further Zool. Res. Swed. Antarctic Exped., Stockholm.
Kungl. Svenska Vetensk. Akad. Handlingar, Stockholm.
Meddelanden Oceanografiska Institutet, Göteborg.
Undersökningar över Öresund, Lund.
Zoologiska Institutionen, Lund. (Contributions)

THAILAND

F. A. O. Current Affairs Bulletin, Bangkok.
Proc. Indo-Pacific Fisheries Council, Bangkok.

TUNISIA

Bulletin Stat. Océanogr., Salammbô.

TURKEY

Publ. Hydrobiol. Res. Inst., Fac. Sci., Univ. of Istanbul. Ser. B, Istanbul.

U. S. A.

Allan Hancock Pacific Expeditions, Los Angeles.
American Museum Novitates, New York.
Annual Rep., Chicago Nat. Hist. Mus., Chicago.
Annual Rep., Mount Desert Islands Mar. Biol. Lab., Salisbury Cove.
Annual Rep., Mus. Comp. Zool. Harvard Univ., Cambridge.

- Bull. Amer. Mus. Nat. Hist.*, New York. (Marine biology)
Bull. Bernice P. Bishop Mus., Honolulu. (Zoology and Entomology)
Bull. Bingham Oceanogr. Coll., New Haven.
Bull. Duke Univ. Mar. Station, Beaufort.
Bull. Mus. Comp. Zool. Harvard Univ., Cambridge. (Marine zoology)
Bull. Scripps. Inst. Oceanogr., La Jolla.
Bull. U. S. Nat. Mus., Washington.
California Fish and Game, San Francisco.
Duke Univ. Mar. Stat., Beaufort. (Contributions, Ser. A)
Educational and Technical Series, Florida State Board of Conserv., Coral Gables, Florida.
Fieldiana-Zoology, Chicago Nat. Hist. Mus., Chicago. (Ichthyological papers).
Fish Bulletin, Division of Fish and Game, San Francisco.
Fishery Bulletin, U. S. Fish and Wildlife Service, Washington.
Fisheries Statistics of the United States, U. S. Fish and Wildlife Service, Washington.
Hopkins Marine Station, Pacific Grove. (Reprints)
Jour. Entom. Zool., Claremont.
Mem. Bernice P. Bishop Mus., Honolulu.
Mimeographed Rep., Univ. of Miami Marine Lab., Coral Gables.
Occasional Papers, Bernice P. Bishop Mus., Honolulu. (Zoology and Entomology)
Pacific Science, Honolulu.
Proc. Gulf and Caribbean Fish. Inst., Coral Gables.
Proc. U. S. Nat. Mus., Washington. (Marine zoology)
Publ. Inst. Marine Science, Port Aransas.
Publ. in Oceanography, Univ. of Washington, Seattle.
Publ. in Oceanography, Suppl. Series, Univ. of Washington, Seattle.
Records of Observations, Scripps Inst. of Oceanogr., La Jolla.
Research Report, U. S. Fish and Wildlife Service, Washington.
Scripps Inst. of Oceanogr., La Jolla. (Contributions).
Sears Foundation Jour. of Marine Research, New Haven.
Special Publ., Univ. of Miami Mar. Laboratory, Coral Gables.
Trans. Kentucky Acad. Sci., Lexington.
Univ. of Miami Marine Laboratory, Coral Gables. (Contributions)
Woods Hole Oceanographic Institution, Woods Hole. (Collected Reprints)

PUBLICATIONS

The outcome of researches made at the Laboratory has been published in the own journal "*Publications of the Seto Marine Biological Laboratory*" (commenced in 1949) and other periodicals at home or abroad. Several of them are being selected and sent regularly to the marine laboratories, institutions, museums, departments, etc. in exchange, under the subtitle of "*Contributions from the Seto Marine Biological Laboratory*", formed of two separate series, of articles in foreign and Japanese languages (*Vide infra*).

EXPLANATION OF PLATES II—V

PLATE II

Fig. 1. Plan of ground and buildings of the Laboratory. 1,2240. A-C, Official residences. D, Dormitory. E, Special research laboratory. F, Research laboratory. G, Students' laboratory. H, Museum. I, Aquarium and Specimens gallery. J, Summer house, used as dormitory. K, Meteorological observatory. L, Fresh-water pool. M, Sea-water pool for sea-turtles. N, Sea-water reservoir. O, Bansyoyama botanical garden.

PLATE III

Fig. 2. Aerial view of Tanabe Bay from the south.

Fig. 3. General view of Kanayama Bay and Seto Peninsula, showing the site of the Laboratory (S.M.B.L.).

PLATE IV

Fig. 4. Research laboratory.

Fig. 5. Special research laboratory.

PLATE V

Fig. 6. Students' laboratory.

Fig. 7. Aquarium.

Fig. 1

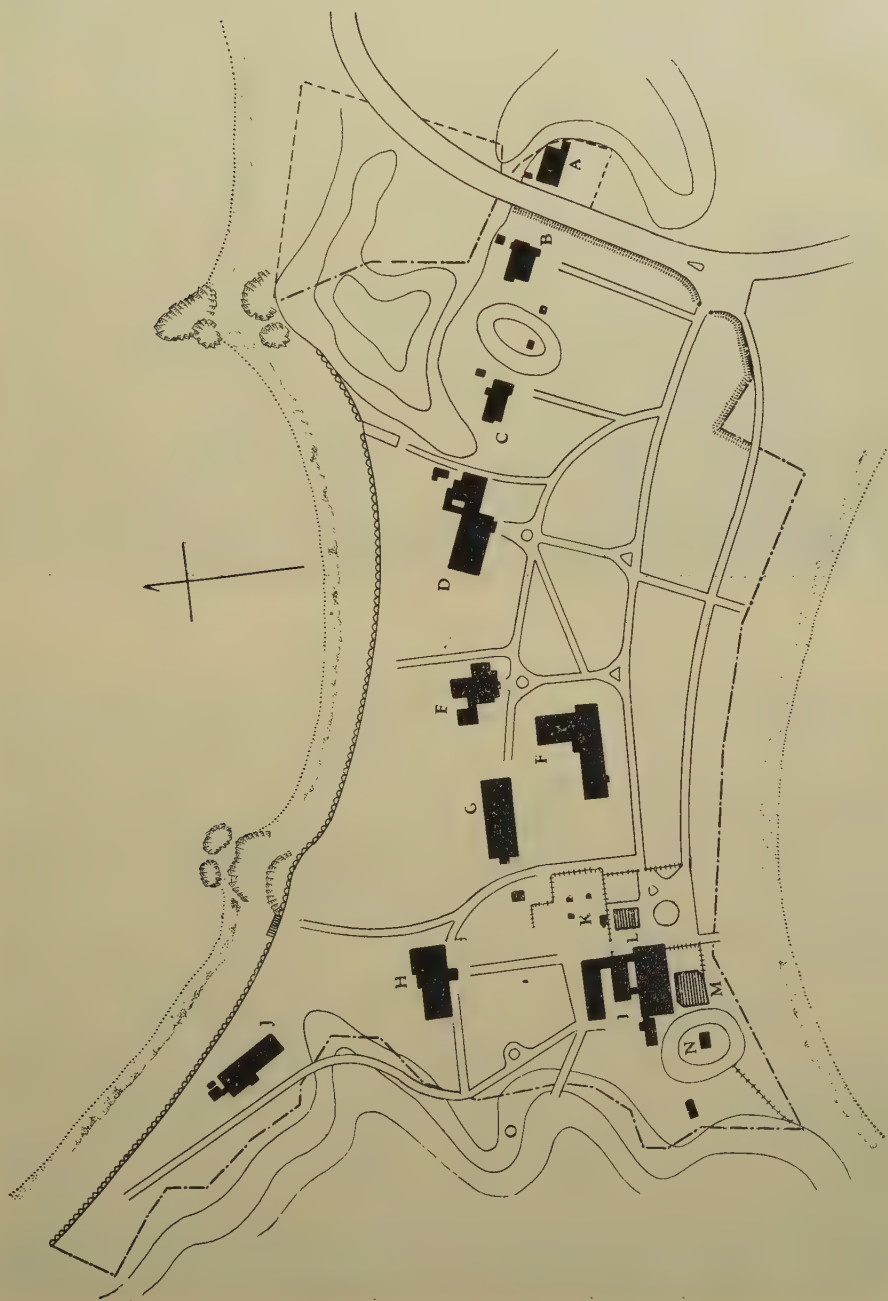


Fig. 2



Fig. 3

S. M. B. L.

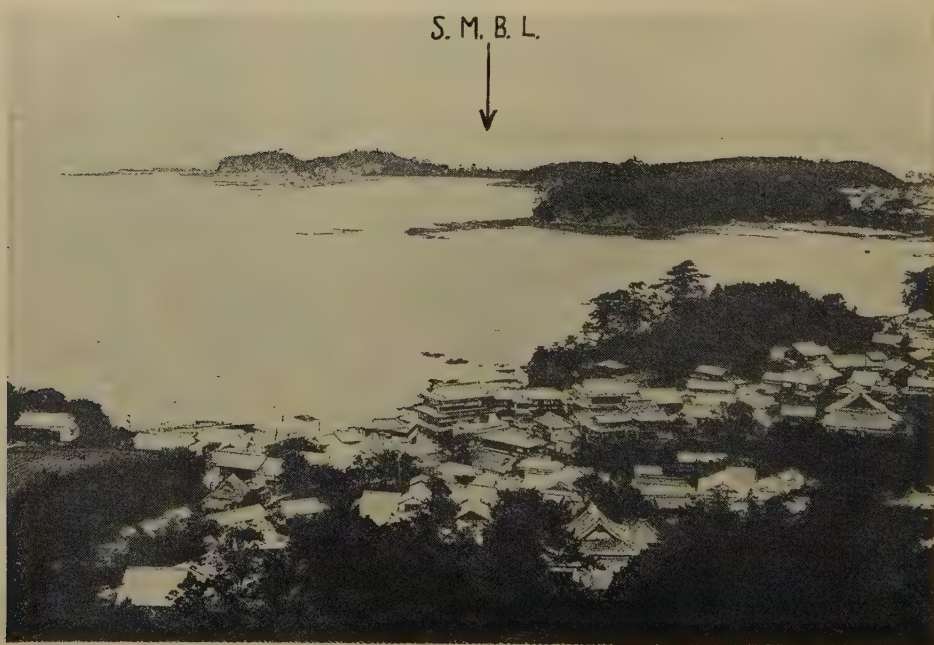


Fig. 4



Fig. 5



Fig. 6



Fig. 7



A NEW GENUS AND TWO NEW SPECIES OF THE ORDER TANAIDACEA FOUND AT SETO*

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With 7 Text-figures

In two of my previous papers (SHIINO, 1951, 1951a), I reported five species of the Tanaid crustaceans occurred in the shore waters at Seto. Here I describe three more species which have been added to my collection from this locality afterwards. Of these, one appears to represent the type of a new genus of the family Tanaidae, being characterized by the possession of appendages much simplified in their structure. The other two are also new to science and can apparently be designated to the genus *Apseudes* of the family Apseudidae. They are remarkable for the fact that they have come from the littoral zone, while the majority of the forms belonging to this genus was discovered from the sea-bottom, if not abyssal in habitat.

Apseudes algicola n. sp.

(Figs. 1-3)

Habitat: Littoral, found among algae or on the surface of sponges. Eleven females and two males.

A dimorphism is observed in the gnathopoda of the male and female.

Female: Depressed, elongate, somewhat attenuating posteriorly; 3.0 mm long excluding appendages and 0.6 mm wide at the second pereiomere. Integument rather thin, transparent, colorless. All somites more or less setose both on dorsal face and on free borders.

Carapace one fifth the length of the body and nearly as long as wide. Anterior margin, without forming a rostrum, round and continuing back to the

* Contributions from the Seto Marine Biological Laboratory, No. 176.

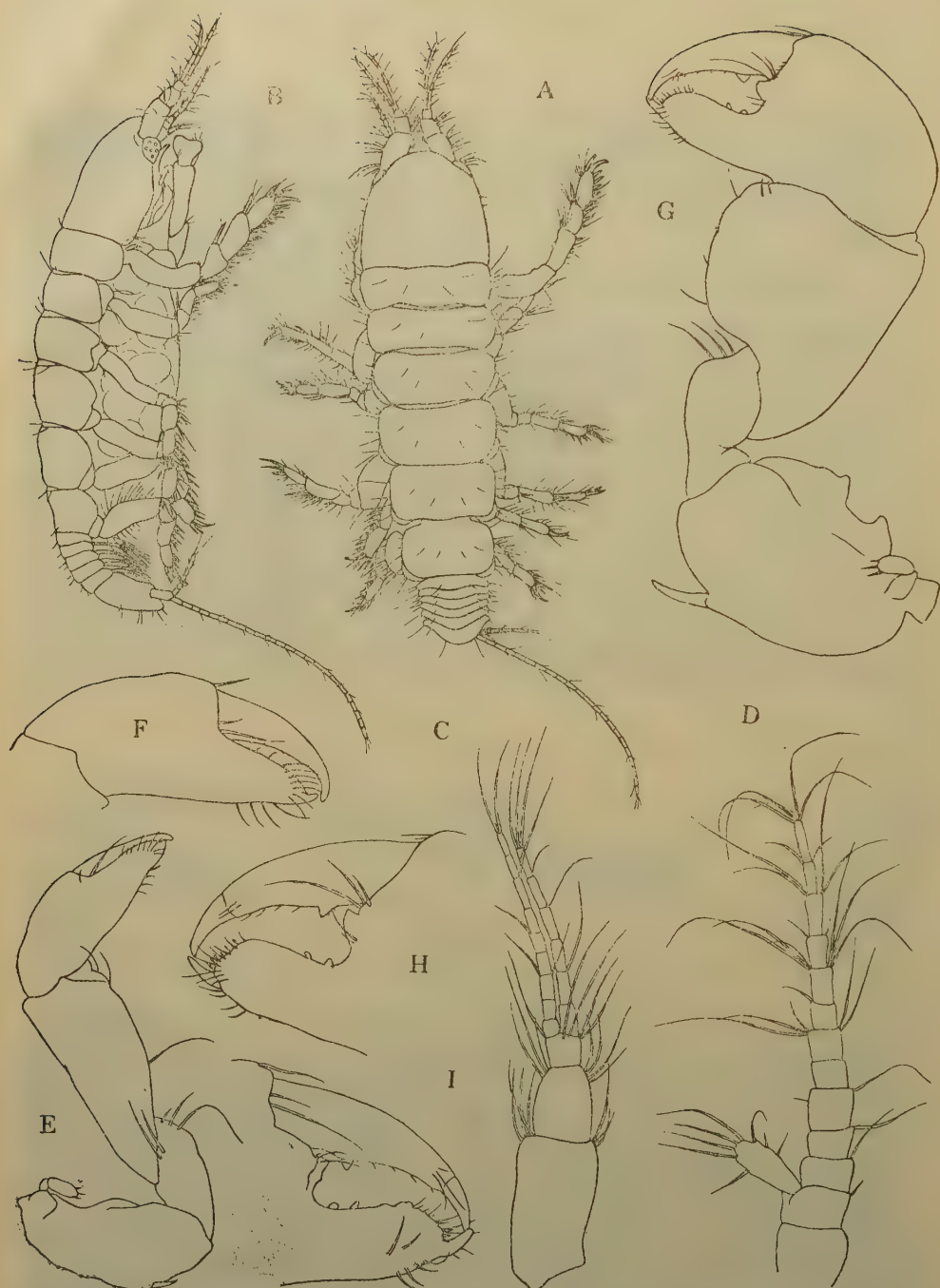


Fig. 1. *Apsaudea algicola* n. sp. A-F, ♀ female; A, dorsal view; B, lateral view; C, antennule; D, antenna; E, right gnathopod; F, chela of the same; G-I, male; G, left gnathopod; H, chela of the same, viewed from the outside; I, same, viewed from the inside. A-B×27; C, E-G×90; D, H, I×123.

slightly-curved lateral sides. Posterior border almost straight. Dorsal face convex. Eye lobe distinct, but remaining to expose a small part of it dorsally and lacking retinal pigment.

Pereion a little more than half the body length, with the somites contiguous and rectangular having widely round sides. First somites (second pereiomere) as long as the second and shorter than others which are subequal to one another. It is as wide as the carapace, the remainder decreasing in width from front to rear. Small, semicircular coxal plates present on the pereiomeres from the third backwards.

Pleon six-segmented, almost as long as the carapace, and narrower than the last pereiomere. First five segments similar in size, transversely linear with round lateral ends. Last somite equals in length to the preceding five combined. It is as long as wide, slightly attenuating backwards, and ending in a crescent median lobe between the uropoda.

Antennule as long as the carapace, biramous, with hairy joints. First of the three joints of peduncle very thick, elongated, twice as long as the second. Third shortest and thinnest. Two subequal flagella shorter than the peduncle, the outer member eight- or nine-jointed and the inner six-jointed. Antenna shorter than the antennule, composed of about thirteen joints tapering little by little towards the tip. Its distal half encircled by long setae at the end of every two joints. Second joint bears an elongate-oval, setiferous scale. Epistome has a sharp spine. Labrum linguiform, with its margin a trifle sinuous on the median. Labium bilobed, furnished with an oval, setaceous accessory lobe on either side. Molar process of mandible columnar, with striated triturating surface. Incisor process five dentate, accompanying four or five forked spines at the base. Lacinia mobilis, divided into four teeth, present only on the right side. Apical joint of palp with a row of setae along the inner border, whereas the other joints setose only in their terminal parts. Inner lobe of maxillula has five ciliated spines and the outer lobe nine apical teeth besides two smaller sub-apical ones. Maxilla divisible into four lobes. Innermost of these broadest, retreating from others and emarginated by short hairs mingled with some long spines. Second lobe much narrower, bearing forked spines. Third with simple, curved spines and the outermost acuminate, ending in a single one. Basis of maxilliped wider distally than proximally, having the endognath fringed by blunt spines along the inner half of its round margin. First joint of the palp short, as wide as the basis, with a minute spine at the outer angle. Second the same in width, but far longer, and with double row of spines along the inner border. Remaining two joints much narrower, bearing a single spine-row. Epipodite a lozenge-shaped plate, without marginal setae except for having two short filiform processes.

Gnathopod slender, with a minute, two-jointed, setae-tipped exopodite. Basis and ischium fused into a single article bearing a small spine on the posterior border. Merus and carpus obliquely articulated with each other, but on the same straight line. The latter longer than the former and the both with some hairs. Chela more than twice longer than wide. Immovable finger shorter than palm, ending in a small tooth, and with a row of setae along the cutting edge as well as on the outer border. Palm also with a few hairs close

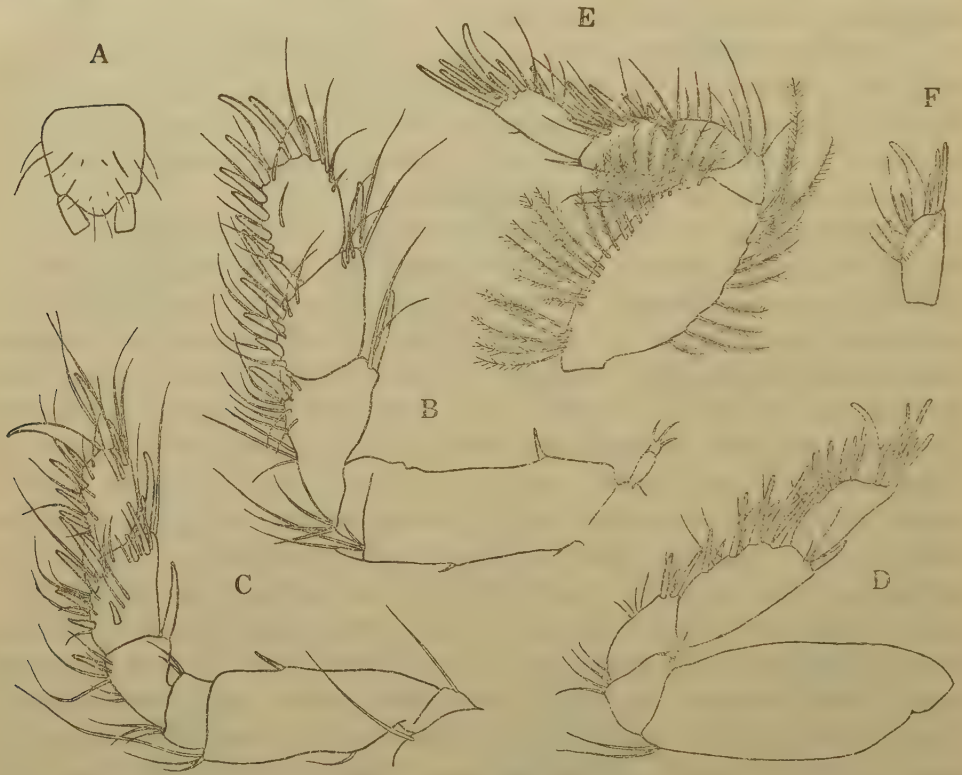


Fig. 2. *Apsaude algicola* n. sp., female. A, pleotelson, dorsal view; B-F, pereopoda from the left side; B, second; C, third; D, sixth; E, seventh; F, same viewed from the inside. B-F $\times$ 90; A $\times$ 123.

to the base of the finger. Movable finger curved well in its attenuated terminal part and with very minute hairs on the cutting edge. Other pereopoda ambulatory, having segments heavily armed with spines and setae. Segments of second pereopod broader than those of the succeeding limbs. It has a two-jointed exopodite. Its basis somewhat incompletely separated from the short ischium and with a spine on the dorsal border as well as at the end of the

ventral. Merus has a longer terminal spine on each of the two margins. Carpus and propodus provided on the ventral border with five and six spines respectively; the former with one spine at the dorso-distal angle, while the latter with two. Dactylus unguiform, only slightly larger than the terminal spine of propodus. Third and fourth limbs resemble the second in structure, but possess narrower joints. Their basis distinctly separated from the ischium and without terminal spine. Carpus and propodus have additional spines on the outer surface. Dorso-distal spine of merus is replaced by a hair in the fourth limb. Succeeding two pereopoda different from the foregoing ones in the arrangement of spines, in having fewer setae and somewhat broader basis. Merus with three spines at the ventro-distal angle, but devoid of the dorsal one. Ventral spines of carpus more numerous than in the foregoing limbs and forming a double row. This joint bearing three dorsal spines in the fifth limb, while only one in the sixth. Propodus with several spines at its dorso-distal end. Basis of seventh limb has a row of long plumose setae along the dorsal as well as the ventral borders, the propodus possesses an oblique row of very minute hairs on the outer face close to the distal end, and the merus lacks the ventral spine. In other points, this limb resembles the sixth. Marsupium large and sac-like.

Five pairs of pleopoda biramous. Protopodite with short plumose setae on both margins, and the two, narrow, subequal rami with similar, but much longer marginal hairs. Uropod biramous, filiform, attaining about half the length of the body. Peduncle one jointed, much thicker and longer than any of the articles of the rami and with some hairs at the end. Endopodite composed of twenty-seven or more joints, and about four times as long as the six-jointed exopodite. Besides terminal hairs, both rami scatteredly setose along their lengths.

Male: Distinguishable from the female by having a larger, stouter gnathopod. Basis of this limb much broader than in the female, with a stronger spine on the ventral margin and with two irregularly-shaped processes on the dorsal. Carpus expanded ventrally so as to form a round plate. Palm of chela broad, furnished with some hairs on the border articulating with movable finger and a triangular tubercle between this and the base of immovable finger. Immovable finger more or less cylindrical. Its round end hairy, besides projecting a claw. Cutting edge bears two small tubercles in the proximal part. Dactylus, when closed, leaves a space between itself and the immovable finger and has a triangular tubercle on the inner border close to the base. Otherwise, no differential characters between the two sexes.

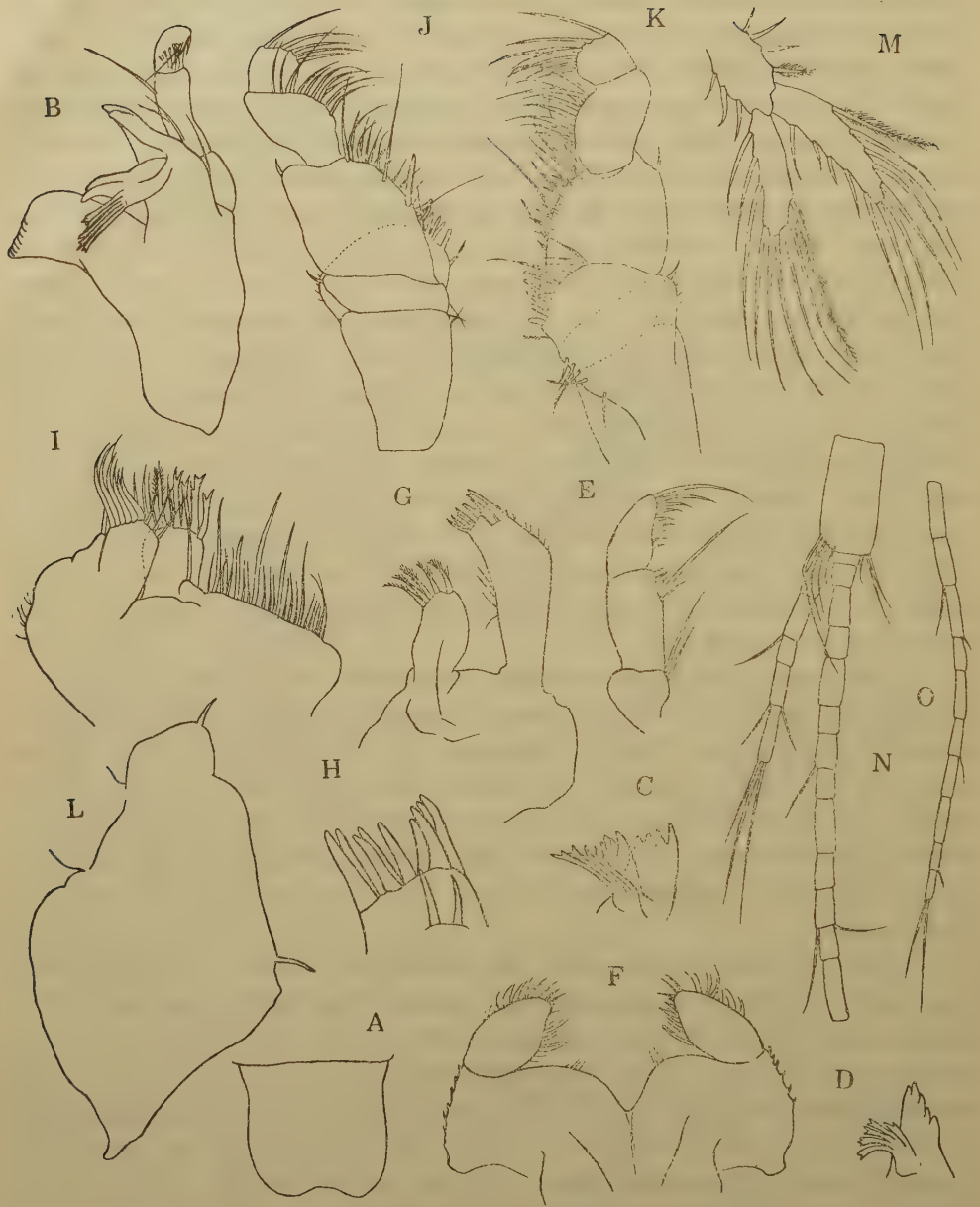


Fig. 3. *Apsudes algicola* n. sp., female. A, labrum; B, left mandible; C, incisor process of the same; D, incisor process of right mandible; E, mandibular palp; F, labium; G, maxillula; H, tip of outer lobe of the same; I, maxilla; J, maxilliped, viewed from the outside; K, same, viewed from the inside; L, epipodite of the same; M, pleopod; N, uropod; O, tip of endopodite of the same. M-O $\times$ 123; A-G, J-L $\times$ 176; I $\times$ 348; H $\times$ 500.

Apseudes littoralis n. sp.

(Figs. 4 & 5)

Habita': Littoral, found among barnacles grown over coast rocks. Four female specimens.

Female: Depressed, elongated and narrow, slightly attenuating posteriorly; 2.2 mm long exclusive of the appendages and 0.42 mm wide at the second pereiomere. Somites more or less hairy, semitransparent and colorless without any pigment.

Carapace less than one fourth the length of the body, longer than wide and a trifle wider posteriorly than anteriorly. Anterior margin triangular having a median point and very slightly wavy on either side of it. Lateral border also undulated and posterior side widely convex. Surface nearly hairless. Eye lobe a crescent shape in dorsal view and lacking retina pigment.

Pereion half as long as the body, with somites and coxal plates sparingly hairy. First somite (second pereiomere) has lateral parts somewhat produced forwards and equals in length to the third which has round sides. Succeeding two longer than these, subequal to each other and with two tubercles on either lateral border, one in its anterior part, and the other at about its middle. Remaining somites intermediate in length, having two sides inclined inwards in front of as well as behind the single lateral tubercle. Posterior border of them concave. Crescent-shaped coxal plates occupy the anterior part of the lateral sides in the first somite, while the posterior part in the others. Marsupium enormous.

Pleon two sevenths the length of the body, with somites hairy both on surface and on margin. First five somites very short antero-posteriorly, somewhat turning backwards in their round lateral ends. Last somite as long as these combined, longer than wide, with a V-shaped posterior and undulated lateral borders.

Antennule longer than the carapace, biramous, with more or less hairy joints. First joint of peduncle columnar, very thick and long, occupying less than half the entire length of antennule. Second joint not attaining the half of the first, but longer than the third. Two rami filiform, with the outer member five-jointed and longer than the two-jointed inner member. Antenna shorter than the antennule, composed of about ten sparingly-setose joints. Second joint bears a short, slender, setae-tipped scale. Labrum and labium ordinary in structure, the latter bearing a fusiform accessory lobe on either side. Molor process of mandible columnar, striated on its triturating surface. Incisor process four-toothed, accompanying five or six ciliated spines at the

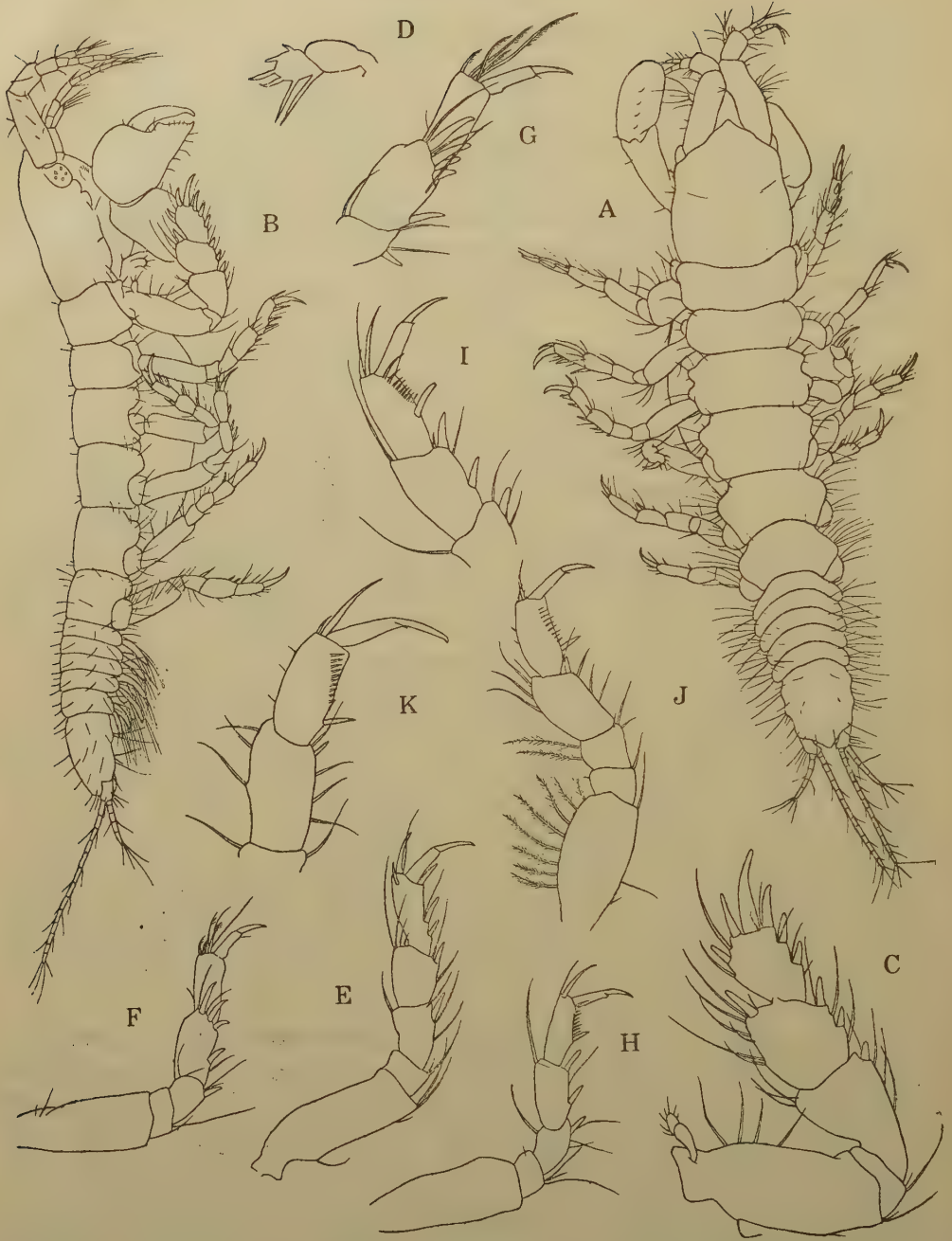


Fig. 4. *Aapseudes littoralis* n. sp., female. A, dorsal view; B, lateral view; C-K, pereopoda from the right side; C, second; D, exopodite of the same; E third; F, fifth; G, same; H, sixth; I, same; J, seventh; K, same. A, B $\times 40$; C, E, F, H, J $\times 90$; G, I, K $\times 123$; D $\times 176$.

base. Lacinia mobilis tridentate, present only on the left mandible. First joint of palp short, spinous at its end. Second far longer, with some short spines along the terminal part of the inner margin. Third curved, with a spine-row along its entire length. Maxillula has four ciliated spines on the inner lobe and about twelve teeth on the outer. Two-jointed palp directs backwards ending in two long hairs. Of four lobes of maxilla, the second one from the outside projecting beyond others and the innermost retreating. These two have a row of simple setae along their borders. Third lobe with forked spines and the outermost fringed by ciliated spines besides two long simple ones. Basis of maxilliped rectangular, with a long ciliated spine at the inner distal angle. Gnathobasis hairy, and provided with apical rows of short spines besides two retinacula on the inner border. First joint of palp short, bearing a long ciliated spine on the inner border, second much longer, also with a number of similar spines besides more numerous simple, shorter ones. Both of them with a short spine on the outside. Apical two joints wearing long simple spines along their inner border. Epipodite curved, irregular in shape ending in a large spine.

Gnathopod robust, with joints expanded and arranged in an S-form. Basis and ischium fused into a single joint which bears two-jointed, setae-tipped exopodite at the narrowed base and some setae on the well-curved ventral border. Merus small, perpendicular to the basi-ischium. Carpus as long as basi-ischium, triangular, widening distally. It articulates with the merus by the proximal half of its ventral border and bearing two acuminate processes as well as a few setae on the distal half. Chela less than twice longer than broad, one and half times as long as basi-ischium and with a sparse row of setae on the ventral border. Immovable finger shorter than the swollen palm, from which it arises with a broad base and narrows towards the tip. Cutting edge has a long hair and a triangular tubercle at the base, which is followed by a convexity bearing a row of fine hairs, and ends in a pointed process. Movable finger curved not much, ciliated on the inner border and with a setae-bundle at the base of sharp claw. Segments of second pereopod broader than those of the succeeding limbs. Basis distinct from the very short ischium, furnished with a two-jointed minute exopodite and some long setae on the dorsal border. Segments from the merus to propodus armed with setae and spines. The latter is present one on merus at the ventro-distal angle, two on carpus on the ventral border and one on the dorsal, three on propodus on the ventral side and two on the opposite side. Other pereopoda more slender and purely ambulatory in function. Third and fourth limbs identical with each other in structure. Their basis lacks dorsal setae, merus as well as carpus bears a single spine at the ventro-distal angle and propodus has three

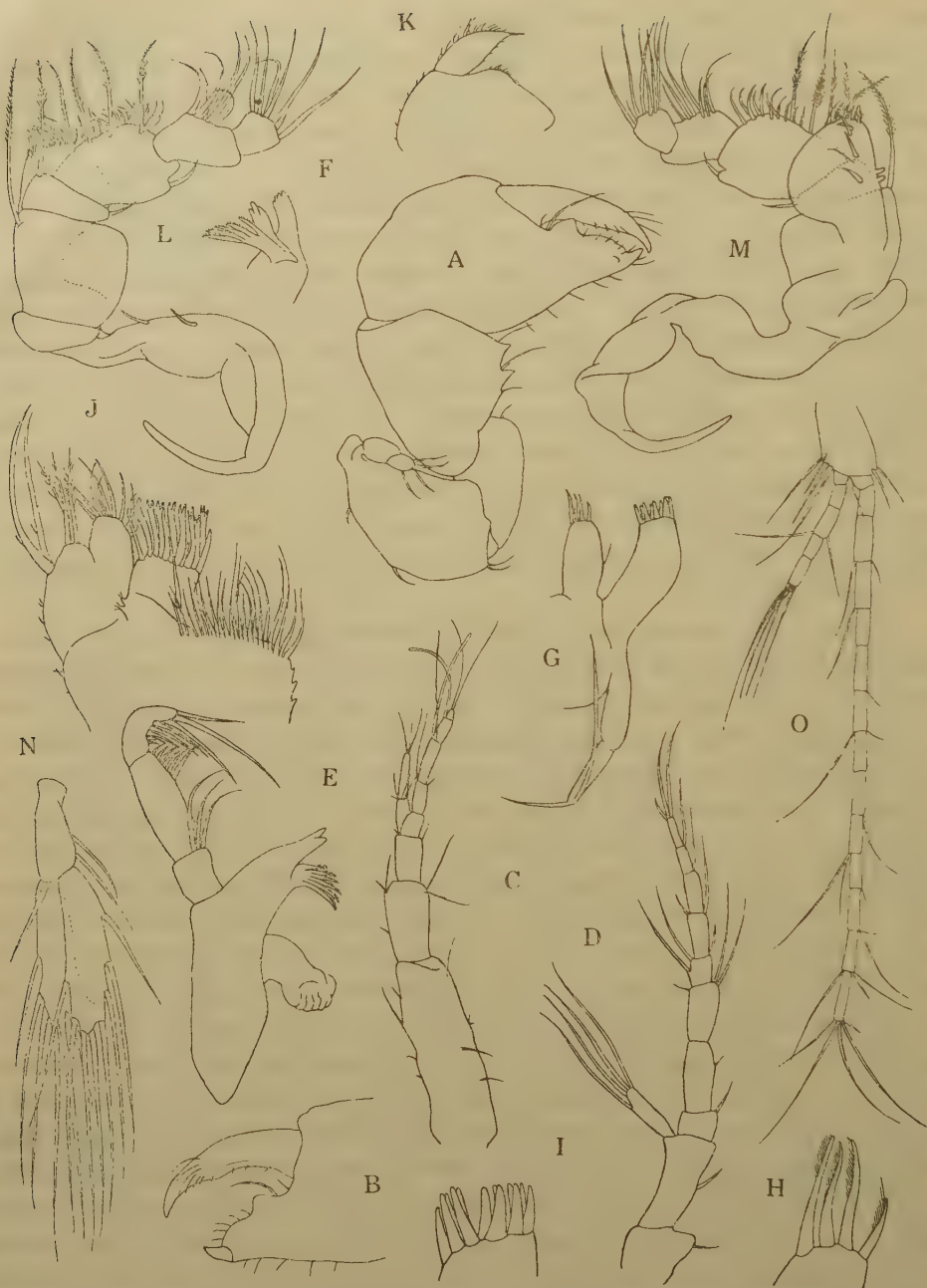


Fig. 5. *Apsudes littoralis* n. sp., female. A, right gnathopod; B, chela of the same, viewed from the inside; C, antennule; D, antenna; E, right mandible; F, incisor process of left mandible; G, maxillula; H, inner lobe of the same; I, outer lobe of the same; J, maxilla; K, right half of labium; L, maxilliped, viewed from the outside; M, same, viewed from the inside; N, pleopod; O, uropod. A-D $\times$ 90; O $\times$ 123; E, G, K-N $\times$ 176; F, J $\times$ 348; H, I $\times$ 500.

on the ventral border and two at the dorso-distal end. Other pereiopoda resemble them except in the following points. In fifth limb, carpus has one spine on the ventral side and four on the posterior surface along the terminal border. Propodus bears several pectinate slender ones at the dorso-distal angle. Carpus of sixth limb possesses two ventral spines but lacks the distal one of the posterior surface. Its propodus has, besides a slender dorso-distal one, a spine about the middle of the ventral border from which minute hairs are arranged in a row up to the end of the segment. This segment of the seventh pereiopod resembles that of the sixth, but the carpus has only a ventro-distal spine, the merus bears two, long, plumose, dorsal hairs instead of the ventral spine and the basis is provided with a dorsal row of similar setae.

Five pairs of pleopoda composed of a slender protopodite and two, narrow, subequal rami. Protopodite with two setae on the inner side besides with an apical one and the rami fringed by longer setae. Uropod only slightly shorter than the pereion, and with two unequal filiform rami. Its peduncle non-articulated, rather thick, bearing some setae at the end on the outside as well as on the inside. Outer ramus five-jointed, nearly a quarter as long as the inner ramus which consists of about fourteen joints. Both are scatteredly setose besides having an apical bundle of long setae.

Genus *Metatanais* n. gen.

Body cylindrical, with carapace, six pereiomeres, five pleomeres and pleotelson distinct. Eye well developed. Antennule uniramous, three-jointed; antenna lacking a scale, six-jointed. Mandible without palp. Maxillula with inner lobe atrophied, but with palp well-developed. Maxilla absent. Gnathopod and second pereiopod devoid of exopodite. Coxal plates fused with somites. Pleopoda degenerated in a great measure. Uropod uniramous.

In the cylindrical body, in the uniramous antennule, in the character of the oral appendages and in the absence of the exopodite from the first two pairs of thoracic limbs, the new genus belongs, without doubt, to the family Tanaidae. It is in accord with *Heterotananais*, *Paratanais*, *Typhlotananais*, and *Pseudotananais* in the number of segments composing the two pairs of antennae, but can be distinguished from them, before everything, by its unbranched uropoda. Moreover, it is different from them except the last named genus in the pleopoda being highly degenerated. In this point, the new genus is closer to *Pseudotananais*. This genus, however, has atrophied eyes and the fifth and sixth pereiomeres which are far longer than other somites. *Agathotananais*, *Leptognathia*, *Leptognathiella*, *Tanaella*, *Strongylura*, and *Strongylurella* also bear some

resemblance to the present genus in the possession of rudimentary pleopoda or in the complete absence of these. But, they are quite different from *Metatanaïs* either in the character of the two pairs of antennae, or in that of the uropoda, besides in the poor development of the eye in all of them.

Metatanaïs cylindricus n. sp.

(Figs. 6 & 7)

Habitat: Littoral, found among algae, on the surface of ascidians or of sponges. Neither rudiments of oostegite nor male genital papillae on the seventh pereiomere are discovered in any of the twenty-three specimens collected. They may probably represent the female sex.

Female: Body cylindrical, 1.87 mm long excluding antennule and 0.54 mm wide at the sixth pereiomere. Integument rather thick, opaque and whitish without developing any pigment except that of eye. A narrow, semitransparent band borders the posterior side of carapace and of each pereiomere. A similar longitudinal band also separates a small lateral area from the mid-dorsal region on both sides. All somites almost destitute of setae.

Carapace one fifth the length of body, as long as wide, and narrowed forwards with the two sides arcuate but converging. Anterior margin a flattened V-shape, being obtusely angular on the median and with a pair of lateral excavations in each of which a round, thickly pigmented eye lodges. Posterior border nearly straight. Dorsal face strongly convex.

Pereion a little less than half the body length. Somites highly arched dorsally, with lateral parts bending downwards. Each of them shows a rectangular appearance when viewed from above, borders between consecutive two of them being transversely straight. Fourth somite (fifth pereiomere) longest, foregoing two and succeeding one somewhat shorter and equal to one another. First somite again shorter and the last shortest, being half as long as the fourth. All of them subequal in width. Lateral margins acuminate in the first three somites, but more or less round in others. Coxal plate undefined in any of them.

Pleon a little longer than a third of the body, six-segmented. First five somites occupying about two thirds of the pleon and subequal to one another both in length and in width. They are strongly convex above, with lateral parts bending down, and concave on the ventral side. Last somite thick dorso-ventrally, twice as wide as long, cordiform having the posterior border round, but slightly produced on the median.

Basal joint of uniramous antennule very thick, columnar, half as long as

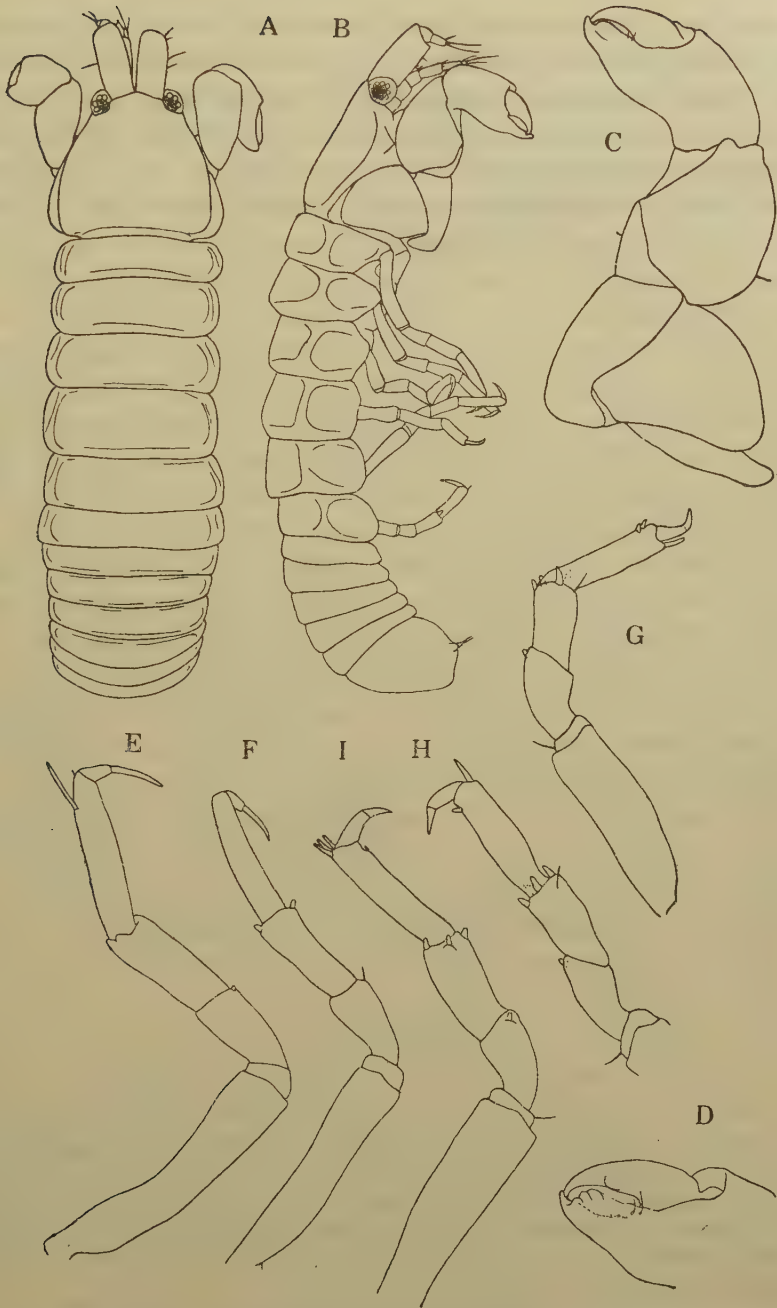


Fig. 6. *Metatanais cylindricus* n. gen. & n. sp., female. A, dorsal view; B, lateral view; C-I, pereopoda from the left side; C, gnathopod; D, chela of the same; E, second; F, third; G, fifth; H, sixth; I, seventh. A, B $\times 45$; C $\times 90$; E-I $\times 124$; D $\times 133$.

the carapace, and sparingly setaceous on the ventral border. Flagellum very short and thin, two-jointed, and tipped by a few long setae. Antenna almost as long as the antennule and composed of six joints, of which the very minute terminal joint bears long hairs. Molar process of mandible rather thick, with uneven triturating surface. Incisor process divided at its tip into unequal denticles and devoid of the basal setae-row. Lacinia mobilis and palp absent. Maxillula lacks the inner lobe. Its narrow, elongate outer lobe has an apical

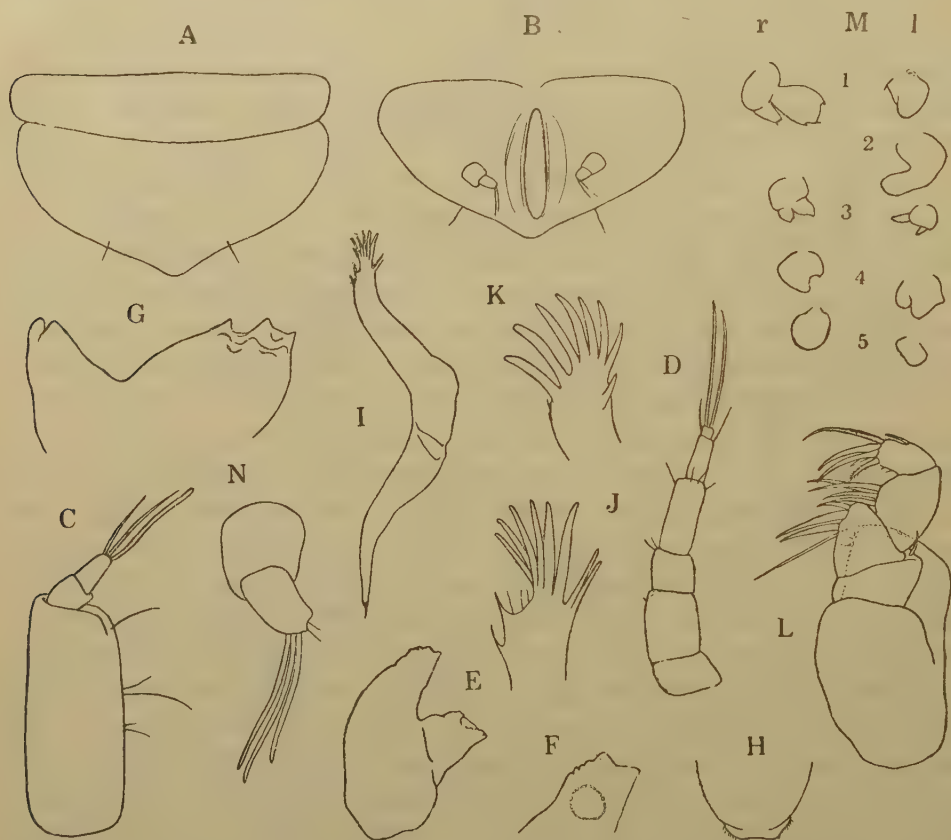


Fig. 7. *Metatanais cylindricus* n. gen. & n. sp., female. A, fifth pleomere and pleotelson, dorsal view; B, pleotelson ventral view; C, antennule; D, antenna; E, mandible; F, incisor process of the same; G, apical part of mandible; H, labrum; I, maxillula; J, tip of the same; K, same; L, maxilliped; M, pleopoda in situ (r, right side, l, left side, numerals indicating the number of pleopoda); N, uropod. A, B $\times 90$; C, D $\times 123$; E, M, I, L $\times 176$; F, G, M, N $\times 348$; J, K $\times 500$.

ring of eight spines besides a few setae, and continues at the base to a long, posteriorly directed palp which ends in a short spine. Maxilla undiscovered. Maxilliped of right and left tightly fused together on the coxal segment.

Gnathobasis broad, but remaining to possess a single long spine at the inner distal angle. First joint of palp short, with a minute spine at the outer distal angle, second triangular, with stouter ones on the broader inner border, and the rest two narrower, also spiny along the corresponding border.

Gnathopod stout, extending forwards beyond the carapace, and thicker proximally rather than distally. Basis fused with ischium forming a triangular segment. It has curved anterior margin and articulates with the carapace by the straight posterior side and with the merus by the entire distal border. Merus comparatively larger than usual, curving at the base so as to embrace the distal part of basis from below. Carpus has dorsal side evenly round. Propodus narrower than carpus, twice as long as broad. Immoveable finger shorter than palm, more or less straight, with an inconspicuous tubercle close to the base of the terminal claw. Dactylus sharp and well curved. Other pereiopoda slender ambulatory, and almost devoid of hairs. They have a distinct but very short ischium and resemble one another, differing only in the number of spines found on the joints from merus to propodus. Third and fourth pereiopoda are identical even in this point. Merus has a minute spine at the ventro-distal angle in the fifth to seventh limbs, but lacks it in the others. Carpus bears two distal spines in the third and fourth limbs, four in the succeeding two and three in the last. Propodus possesses a dorso-distal spine in the second limb, a ventro-distal one besides the dorsal one in the sixth, two ventral and one dorsal in the fifth, three dorsal in the seventh, and none in the remainder. Terminal claw of dactylus distinct. Basis as well as ischium spineless in all pereiopoda.

Pleopoda very rudimentary, represented by minute biramous lobes or by single lobes, or sometimes entirely atrophied. Uropoda present on the ventral side of the pleotelson as minute, two-jointed, setae-tipped appendages.

LITERATURE

- BARNARD, K. H. 1914. *Ann. S. Afr. Mus.*, vol. 10, 325a-442.
 ———— 1920. *Ibid.*, vol. 17, 319-438.
 BEDDARD, F. E. 1886. *Challenger Report, Zool.*, vol. 17, 109-134.
 BOONE, P. L. 1923. *Proc. Biol. Soc. Wash.*, vol. 36, 147-156.
 CHILTON, C. 1882. *Trans. Proc. New Zealand Inst.*, vol. 15, 145-150.
 ———— 1883. *Ibid.*, vol. 16, 249-265.
 ———— 1924. *Mem. Ind. Mus.*, vol. 5, 877-895.
 ———— 1925. *Rec. Ind. Mus.*, vol. 28, 173-185.
 CLAUS, C. 1884. *Arb. Zool. Inst. Wien*, vol. 5, 319-332.
 DOLLFUS, Ad. 1897. *Bull. Soc. Zool. France*, vol. 22, 207-215.
 ———— 1898. *Mem. Soc. Zool. France*, vol. 11, 35-47.
 GRAEFFE, E. 1902. *Arb. Zool. Inst. Wien*, vol. 13, 33-80.
 HALE, H. M. 1929. *Handbooks of the Fauna and Flora of South Australia*, vol. 2, 201-380.

- HALE, H. M. 1933. *Ann. Mag. Nat. Hist.*, vol. 11, 557-561.
- HANSEN, H. J. 1895. *Ergebnisse der Plankton-Expedition*, vol. 2, G. c.; Kiel u. Leipzig.
- 1913. *The Danish Ingolf-Expedition*, vol. 3, no. 3; Copenhagen.
- HASWELL, W. A. 1882. *Proc. Linn. Soc. New South Wales*, vol. 6, 181-196.
- HATCH, M. H. 1947. *Univ. Washington Publ. in Biol.*, vol. 10, 155-274.
- HOLTHUIS, L. B. 1949. *Zool. Mededel.*, vol. 30, 163-190.
- MENZIES, R. J. 1949. *Proc. U. S. Nation. Mus.*, vol. 99, 509-515.
- MILLER, M. A. 1940. *Occ. Pap. Bernice P. Bishop Mus.*, vol. 15, 295-321.
- MONOD, Th. 1923. *Ann. Soc. Sc. Nat. Charente-Infér.*, vol. 37, Fasc. 4, 19-124.
- 1925. *Bull. Soc. Sci. Nat. Maroc.*, vol. 5, 61-85.
- 1926. *Résultats du voyage de la Belgica*, *Rapp. Sci., Zool.*, 1926, 1-67.
- 1931. *Senckenbergiana*, Frankfurt, 13, 10-30.
- 1933. *Mem. Inst. Egypt*, vol. 21, 1933, 161-264.
- MONTAGU, G. 1808. *Trans. Linn. Soc.*, vol. 9, 81-114.
- MOORE, H. F. 1902. *Bull. U. S. Comm. Fish and Fisher.*, vol. 20, pt. 2, 161-176.
- NIERSTRASZ, H. F. 1913. *Siboga-Expeditie*, *Monogr.* 32a, 1913; Leiden.
- NOBIL, G. 1906. *Bull. Mus. Hist. Nat.*, Paris, 1906, 256-270.
- 1907. *R. Acc. Sci. Torino, Mem.*, vol. 57, 351-430.
- NORDENSTAMM, A. 1931. *Nat. Hist. Juan Fernandez Easter Island*, Uppsala, vol. 3, pt. 4, 535-552.
- NORMAN, A. M. 1899. *Ann. Mag. Nat. Hist.*, ser. 7, vol. 3, 317-341.
- 1902. *Ibid.*, ser. 7, vol. 10, 472-486.
- 1907. *Ibid.*, ser. 7, vol. 20, 356-371.
- NORMAN, A. M. and STEBBING, T. R. R. 1886. *Trans. Zool. Soc. Lond.*, vol. 12, pt. 4, 77-141.
- RICHARDSON, H. 1902. *Trans. Connecticut Acad. Sci.*, vol. 11, 277-310.
- 1903. *Bull. U. S. Comm. Fish. Fisher.*, vol. 23, pt. 3, 818-823.
- 1906. *Bull. Mus. Hist. Nat. Paris*, 1906, 187-189.
- 1911. *Ibid.*, 1911, 518-534.
- 1912. *Proc. U. S. Nation. Mus.*, vol. 42, 583-585.
- 1912a. *Ibid.*, vol. 43, 159-162.
- SARS, G. O. 1889. *An Account of the Crustacea of Norway*, vol. 2, Isopoda. Bergen.
- SHIINO, S. M. 1937. *Annot. Zool. Japon.*, vol. 16, 53-62.
- 1951. *Misc. Rept. Res. Inst. Nat. Resources*, nos. 19-21, 32-38.
- 1951a. *Rept. Fac. Fish. Pref. Univ. Mie*, vol. 1, no. 1, 12-25.
- STEBBING, Thomas R. R. 1896. *Ann. Mag. Nat. Hist.*, (6) vol. 17, 49-53, 1 pl.
- 1902. *Mar. Inv. in South Africa*, Cape of Good Hope, no. 12, 1901, 1-92.
- 1910. *Trans. Linn. Soc. London, Zool.*, vol. 14, 83-122.
- STEPHENSEN, K. 1915. *Report on the Danish Oceanogr. Exped.*, vol. 2, *Biol. D* 1, 1-53.
- 1927. *Vidensk. Medd. Naturh. Foren.*, vol. 83, 189-390.
- 1937. *The Zoology of Iceland*, vol. 3, pt. 27, 1-26.
- TATTERSALL, W. M. 1905. Vol. 74th Meet. *Brit. Ass. Adv. Sc.*, 601-602.
- 1921. *Mem. Asiat. Soc. Bengal*, vol. 6, 403-433.
- 1925. *Bull. Soc. Sci. Nat. Maroc*, vol. 5, 77-84.
- VANHÖFFEN, E. von 1914. *Deutsche Südpolar Expedition*, vol. 15, H. 4, 1914.
- WALKER, A. O. 1897. *Journ. Linn. Soc. London*, vol. 26, 226-232.
- WHITELEGGE, Th. 1901. *Austral. Mus. Mem.*, vol. 4, p. 201-246.
- WILLEMOES-SUHM, R. von 1879. *Trans. Linn. Soc. London*, ser. 2, vol. 1, *Zool.* 23-59.
- ZIRWAS, C. 1911. *Wiss. Unters. Biol. Anst. Helgoland*, N. F., vol. 12., Abt. Kiel, 73-118.

ON AN INTERESTING NEW GENUS OF GASTROPOD MOLLUSCA FROM THE SEA OF KII PENINSULA *

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With 4 Text-figures

Among numerous undescribed new genera and species of shells from the Japanese seas, I herewith give the diagnosis of a very interesting new genus. This new species of the genus may probably belong to the family Xancidae (formerly Turbinellidae), which has been represented in Japan by two species of the unique genus *Vasum*. It is a remarkable fact that the present new genus differs not only widely from that genus, but also its shape shows a resemblance to a member of the family Mitridae, except several important features as described below.

*Ceratoxancus*** genus nov.

Type, *Ceratoxancus teramachii* n. sp.

A small shell of about 30 mm in length, much resembling a Mitridae, however, differing in having a sharp labral horn and an operculum. The radula shows some resemblance to Xancidae.

The presence of a horny spine on the outer lip is frequently met with in the members of the genera *Latirus*, *Ancilla*, *Busycon* and *Murex*. The present new genus, though provided with such a horn, stands quite apart from the above-named genera, by the presence of distinct columellar folds as seen in Mitridae, and also by the radular character. A. ADAMS' "*Metula*" *cumingi* (Proc. Zool. Soc. London, (1853): 173, pl. 20, figs. 1, 2, 1855) from the west coast of Africa has some resemblance in form to this shell, but it is never provided with columellar folds.

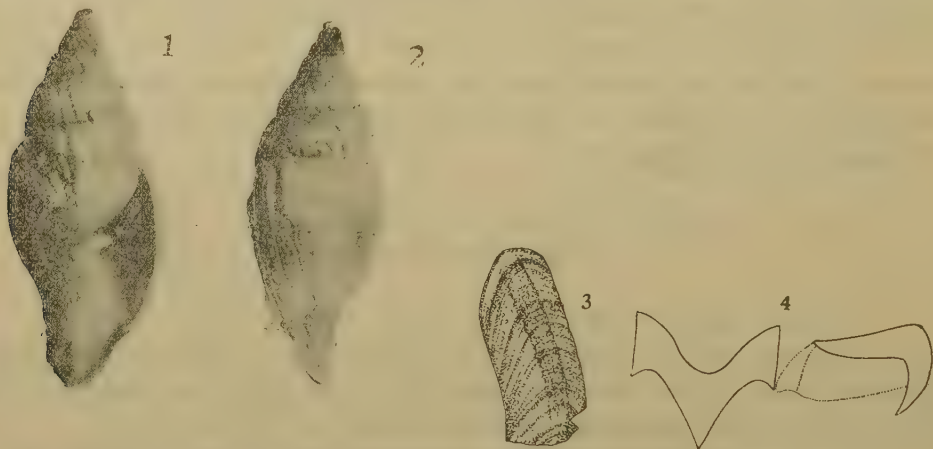
* Contributions from the Seto Marine Biological Laboratory, No. 177.

** keras=horn; xancus=chank, the name of a Hindoo sacred shell.

*Ceratoxancus teramachii** sp. nov.

(Figs. 1-4)

Shell rather thick, fusiform, produced at both ends, somewhat constricted on the base; spire being contained two-fifths in the whole shell length. Whorls moderately convex, retaining $6\frac{1}{4}$ (several apical ones decollated in the type specimen, but a slightly immature paratype from Tosa bears 8 whorls which also lacking the apical ones), with distinct, sub-tabulated and sub-canalculated suture; sculpture distinctly plicated axially by numerous, rounded and somewhat unequal plicae with much narrower interspaces; the plicae are retractorily slanting in front, but they disappear on the last half of the last whorl, which is somewhat roughened by irregular growth striae and inconspicuous spiral threads; the spiral striae are conspicuous on the spire



Figs. 1-4. *Ceratoxancus teramachii* KURODA (gen. et sp. nov.) 1. Frontal, 2. right lateral views of the type, 34.6×14 mm 3. Operculum from the paratype; 4. Rhachidian and lateral teeth of radula from the same. (figs. 3 and 4 were drawn by T. HABE).

whorls, about 12 on a whorl, groovy and more distinct between the axial plicae, but irregular in size and in their arrangements (in the paratype that feature very much resembling some *Nassarius*; the second or third groove from above is larger than the rest which forming a subsutural sulcus). Last whorl large and stout, sub-cylindrical below the constriction which is closely provided with spiral rounded threads, the number of which being about 14 including those on the caudal rostration; the umbilical portion excavated,

* Nom. Jap. "*Fude-gai-modoki*."

bordered by a stout rib of fasciole; aperture narrowly lanceolate; outer lip simple, the margin sharp and retractively oblique towards the base, sinuated at the portion of distance about one-fourth of length of margin from the base, and at the portion just above the sinuation, there is a broken scar of a somewhat sharp horn-like spine which is supposed to be a trace of an immature spine. Canal open and straight; columellar margin straight, provided with 3 somewhat sharp, oblique spiral plicae, the upper ones the larger; the parietal wall oblique, forming an angle at the junction with the outer lip; the throat covered by whitish gray thick enamel. Color of shell somewhat fleshy gray, with an interrupted pale brown zone at the center of the last whorl, and also the base including the caudal rostration is stained broadly with the same color.

Length of shell 34.6, of last whorl 25.6, of aperture 21.8, diam. of shell 14.0, of aperture 6.4 mm.

Type locality: Off Kii Peninsula, collected by Akibumi TERAMACHI more than a decade ago; a single type specimen.

Afterwards, Mr. TERAMACHI collected 2 additional specimens of this interesting rare species from off Tosa (the depth of which supposed to be about 200 fathoms), though both were slightly immature, and one of which contained the animal with an operculum. They wear very thin citrinous yellow periostracum with a slight gloss. The radula has been examined by Mr. T. HABE and here figured by his courtesy. The operculum is delicate, arcuate, dark orangy brown, the terminal nucleus broken off. The measurements of the paratypes from Tosa are as follows:

- (1) $30.4 \times 22.4 \times 18.4 \times 12.4 \times 6.5$ mm., 8 whorls (apical ones lost).
- (2) $27.4 \times 16.5 \times 15.7 \times 10.7 \times 5.9$ mm., 8 whorls, also apical ones not preserved.

PARASITIC GASTROPODS FOUND IN ECHINODERMS FROM JAPAN*

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With Plate VI

Hitherto twenty one species of gastropods parasitic on echinoderms have been recorded from Japan by various authors, such as RANDALL et HEATH (1912), S. HIRASE (1920, 1927, 1932), DALL (1925), GISLÉN (1927), IS. TAKI (1929), IWANOFF (1933), MORTENSEN (1940, 1943), KAWAHARA (1943), HABE (1944, 1950, 1951), KURODA (1949) and KURODA et HABE (1950). In this paper eight more species are added to this list. Of these six are new to science and also parasitic habits are confirmed in other two species which have never been noticed in this country.

It is my pleasant duty to acknowledge here my deep indebtedness to Dr. Taku KOMAI and Dr. Tokubei KURODA for their kind direction and encouragement in the course of my study. My hearty thanks are also due to Prof. Denzaburo MIYADI, Dr. Iwao TAKI, Dr. Huzio UTINOMI, Dr. Takasi TOKIOKA, Messrs. Toshihiko YAMANOUTI, Torao YAMAMOTO, Akibumi TERAMACHI, Masuoki HORIKOSI and Takashi SAITO for their kindness in placing their collections at my disposal.

Family EULIMIDAE

Genus *Balcis* LEACH 1847

1. *Balcis kuronamako* new species

(Pl. VI, Fig. 20)

Shell subulate, slightly bending backwardly on the early whorls, rather solid, milky white except for the snowy white early whorls, smooth and polished; apex rather small but blunt; whorls 11 in number, each whorl rather

* Contributions from the Seto Marine Biological Laboratory, No. 178.

flattened; suture appressed; body whorl two-fifths of the shell length, gently arcuate on the base; varices irregularly disposed on the right side; aperture ovate; outer margin arcuate forwardly; columellar margin thickened and rather straightened; umbilicus closed. Operculum thin, horny, paucispiral as in other eulimids.

Length 8.3 mm, breadth 2.6 mm (figured type specimen).

Habit: On the surface of *Holothuria* aff. *vagabunda* SELENKA—black-coloured littoral sea-cucumber.

Type locality: Shirahama, Wakayama Pref., Honshu.

Di tribution: The coast of Wakayama Pref., Honshu (Shirahama, Fukuro, Miotsu and Satono).

Remarks: *Balcis aciculatus* (PEASE 1860)^{1,2} from Hawaii and *Balcis venus'us* (PEASE 1867)³ from Tahiti are very much allied to this new species. However, both are smaller even in the adult stage and unknown about the parasitic features. *Balcis soliduloides* HABE 1951 is also smaller in size and stouter than the present new species.

2. *Balcis soliduloides* HABE

(Pl. VI, Fig. 25)

1943 *Eulima* sp. KAWAHARA, Botany and Zoology (Japan), 11, p. 976, figs. 3B, C.

1951 *Balcis soliduloides* HABE, Illust. Cat. Jap. Shells, No. 14, p. 94.

Length 7.5 mm, breadth 2.8 mm (figured type specimen).

Habit: On the surface of *Holothuria atra* JAEGER, *Holothuria argus* (JAEGER) and *Stichopus chloronotus* BRANDT.

Distribution: Suô, Formosa (type locality) and Ishigaki-jima.

3. *Balcis yamazii* new species

(Pl. VI, Figs. 6, 9)

Shell acutely pyramidal, somewhat bent to the right side, milky white except for the snowy early whorls, rather solid, smooth and polished; whorls 8 in number; each whorl slightly convex and suture impressed distinctly; all varices decidedly impressed on the right side of each whorl and form a slowly receding ascending line; body whorl one-third of shell length, of which the

1) Proc. Zool. Soc. London, 1860, p. 438.

2) PILSBRY 1917, Proc. Acad. Nat. Sci. Phila., 69, p. 222, figs. 11a, b, pl. 14, fig. 8.

3) Amer. Jour. Conch., 3, p. 294, pl. 24, fig. 24.

periphery obtusely angulated and the base rather flattened; aperture rather small, ovate; outer margin roundly curved, somewhat thickened and forwardly arcuate, columellar margin short, curved and thickened; umbilical fissure present on the outside of it.

Length 7.5 mm, breadth 3.1 mm (figured type specimen).

Habit: On the surface of *Holothuria lubrica* var. *moebii* (LUDWIG).

Type locality: Shirahama, Wakayama Pref., Honshu.

Remarks: *Balcis bovicornus* (PILSBRY 1905)⁴ from Ogasawara Islands has the quite round body whorl. *Balcis tortuosus* (A. ADAMS et REEVE 1850)⁵ from the China Sea is another allied species, but it has slenderer and more distinctly tortuous form. *Balcis kanaka* (PILSBRY 1917)⁶ from Hawaii is a robuster species.

4. *Balcis astropectenicola* KURODA et HABE

(Pl. VI, Fig. 16)

1950 *Balcis astropectenicola* KURODA et HABE, Illust. Cat. Jap. Shells, No. 9, p. 60.

Length 7.2 mm, breadth 2.4 mm (figured type specimen).

Habit: On the oral side of *Astropecten polyacanthus* MÜLLER et TROSCHEL and *Luidia maculata* MÜLLER et TROSCHEL—littoral sea-stars.

Distribution: Tanabe Bay, Wakayama Pref. (type locality) and Miho Bay, Tottori Pref., Honshu.

5. *Balcis robustus* (A. ADAMS)

(Pl. VI, Fig. 4)

1861 *Eulima robusta* A. ADAMS, Ann. Mag. Nat. Hist., (3) 7 (38), p. 125.

1886 *Eulima robusta* TRYON, Man. Conch., 8, p. 271, pl. 68, fig. 25.

1895 *Eulima robusta* PILSBRY, Cat. Mar. Moll. Japan, p. 77.

Length 4.8 mm, breadth 2.4 mm (figured specimen collected from Ago Bay, Mie Pref., Honshu).

Habit: On the oral side of *Astropecten polyacanthus* MÜLLER et TROSCHEL—littoral sea-star.

4) Proc. Acad. Nat. Sci. Phila., 57, p. 111, pl. 11, figs. 9, 10.

5) Zool. Voy. Samarang, Moll., p. 53, pl. 11, fig. 26.

6) Proc. Acad. Nat. Sci. Phila., 69, p. 310, fig. 3.

Distribution: Mishima (=Mino-shima), in the Japan Sea (type locality); Shirahama, Wakayama Pref. and Ago Bay, Mie Pref., Honshu.

6. *Balcis acicula* (GOULD)

- 1849 *Stilifer acicula* GOULD, Proc. Boston Soc. Nat. Hist., 3, p. 84.
 1854 *Eulima vitrea* A. ADAMS, Proc. Zool. Soc. London, (1851), p. 277.
 1854 *Eulima vitrea* A. ADAMS, Thes. Conch., 2, p. 799, pl. 169, fig. 35.
 1862 *Stilifer acicula* GOULD, Otia Conch., pp. 54, 245.
 1865 *Eulima vitrea* SOWERBY, Conch. Icon., p. 19.
 1886 *Eulima acicula* TRYON, Man. Conch., 8, p. 282, pl. 70, figs. 92-95.
 1899 *Eulima vitrea* CLESSIN, Conch. Cab., 1 (28), p. 10, pl. 2, fig. 7.
 1903 *Eulima vitrea* SCHEPMAN, Siboga Exped., monogr. 49c, p. 235.
 1917 *Melanella acicula* PILSBRY, Proc. Acad. Nat. Sci. Phila., 69, p. 223.
 1943 *Mucronalia* sp. KAWAHARA, Botany and Zoology (Japan), 11 (12), p. 976, fig. 3A.

Shell straight, slender, elongate, thin, transparent, smooth and highly polished; apex small, milky white: whorls 12 or 13; each whorl flattened; suture weakly appressed and coloured with lucid white; aperture elongate oval; columellar margin dilated and thickened; outer margin strongly arched forwardly; operculated.

Length 8.7 mm, breadth 2.2 mm (examined specimen collected from Palao).

Habit: In the coelom or on the surface of *Stichopus chloronotus* BRANDT.

Distribution: Fejee Islands (type locality); Hawaii Islands; Palao; Ishigaki Island, Loochoo.

7. *Balcis teramachii* new species

(Pl. VI, Figs. 26, 27)

Shell straight, smooth, glossy and semitransparently milky white; whorls 15 in number, each whorl flattened and suture weakly appressed; body whorl about one-third of the shell length, of which the base is rounded; aperture ovate; outer margin roundly arched and arcuate forwardly; columellar margin slightly curved and thickened; the callus dilated over the umbilical fissure.

Length 8.2 mm, breadth 2.6 mm (figured type specimen).

Habit: On the surface of *Mesothuria parva* (TRÉEL)-- deep-sea sea-cucumber.

Type locality: Tosa Bay, Shikoku.

8. *Balcis peronellicola* KURODA et HABE

(Pl. VI, Fig. 17)

1950 *Balcis peronellicola* KURODA et HABE, Illust. Cat. Jap. Shells, No. 9, p. 60.

Length 4.3 mm, breadth 1.5 mm (figured type specimen).

Distribution: Yura, Wakayama Pref. (type locality); Suiken in Wakayama City and Mukai-jima near Onomichi City, Hiroshima Pref., Honshu.

Habit: Around the mouth of *Peronella japonica* MORTENSEN—a sand-dwelling cake-urchin.

9. *Balcis auratus* (S. HIRASE)

(Pl. VI, Fig. 11)

1920 *Melanella aurata* S. HIRASE, Zool. Mag. (Japan), 32 (385), p. 345, pl. 6.

1927 *Melanella aurata* S. HIRASE, Nippon Dobutsu-Zukan, p. 1462.

Length 4.0 mm., breadth 1.5 mm (figured specimen collected from Shirahama, Wakayama Pref., Honshu).

Habit: On the shell of *Anthocardis crassispina* (A. AGASSIZ)—littoral sea-urchin.

Distribution: Naruto, Tokushima Pref. (Type locality) and Shirahama, Wakayama Pref., Honshu.

10. *Balcis langfordi* (DALL)

1925 *Strombiformis langfordi* DALL, Nautilus, 38 (3), p. 97.

Habit: On the shell of *Anthocardis crassispina* (A. AGASSIZ).

Type locality: Shimoda, Izu Peninsula, Honshu.

11. *Balcis komaii* HABE

(Pl. VI, Fig. 10)

1950 *Balcis komaii* HABE, Illust. Cat. Jap. Shells, No. 6, p. 44.

Length 4.1 mm, breadth 1.9 mm (figured type specimen).

Habit: On the arm of *Comanthus japonicus* (J. MÜLLER)—littoral crinoid.

Type locality: Shirahama, Wakayama Pref., Honshu.

12. *Balcis akauni* new species

(Pl. VI, Fig. 5)

Shell slender, acutely attenuate above, slightly bent to the left side backwardly, thin semitransparent and glassy; whorls 10 in number, each whorl flattened and suture appressed; apex small but blunt; varices impressed and marked with brown-colored stripes, one on each whorl, and they are all on the right side, where they form a stepped ascending line; body whorl rather large and high, a half of shell length, decorated with a narrow brown spiral dotted line at the periphery; aperture elongate oval; outer margin gently curved and arcuate forwardly; columellar margin rather straight, thickened and dilated on the umbilical fissure.

Length 4.6 mm, breadth 1.5 mm, (figured type specimen).

Habit: On the shell of *Pseudocentrotus depressus* (A. AGASSIZ)—littoral sea-urchin.

Type locality: Shirahama, Wakayama Pref., Honshu.

Remarks: This new species may be distinguished from the allied species *Balcis langfordi* (DALL) in having the more slender shell and a dotted brown line at the periphery.

Genus *Stilapex* IREDALE 192513. *Stilapex philippinarum* (SOWERBY)

(Pl. VI, Figs. 23, 24)

1900 *Mucronalia philippinarum* SOWERBY, Proc. Malac. Soc. London, 4, p. 127, pl. 11, fig. 5.

1944 *Mucronalia mitteri* HABE, Jap. Jour. Malac. (Venus), 13 (5-8), p. 192, fig. 14 (non PETIT 1851)

1944 *Mucronalia mitteri* HABE, *l. c.*, p. 312.

Height 10.4 mm, breadth 5.3 mm (figured specimen collected from Shirahama, Wakayama Pref., Honshu).

Height 9.8 mm, breadth 4.8 mm (figured specimen from the same locality).

Habit: On the peristome of *Coscinasterias aculispina* (STIMPSON) — littoral sea-star.

Distribution: Cebu, Philippines (type locality); Amami Islands; Shirahama, Wakayama Pref. and Sagami Bay, Honshu.

Remarks: The head of the animal of this species is white, except for the fleshy orange tentacles. The Siboga specimens obtained from the Pasir Pandjang, Binongka Island (Siboga Station No. 220) and so named, was parasi-

tic on *Heterocentrotus mammillatus* (sea-urchin) and seems to be a distinct species closely allied to this species.

Genus *Mucronalia* A. ADAMS 1860

14. *Mucronalia lactea* (A. ADAMS)

(Pl. VI, Fig. 15)

1863 *Leiostraca* (*Mucronalia*) *lactea* A. ADAMS, Jour. Linn. Soc. London, Zool., 7, p. 91.

1929 *Mucronalia lactea* MAK YAMA, Venus, 1 (5), p. 168.

1944 *Mucronalia lactea* HABE, Jap. Jour. Malac. (Venus), 13 (5-8) p. 312.

1950 *Mucronalia lactea* KURODA et HABE, Illust. Cat. Jap. Shells, No. 9, p. 58, pl. 10, fig. 11.

Length 4.8 mm, breadth 1.8 mm (figured specimen collected from Hatakejima in the Tanabe Bay, Wakayama Pref., Honshu).

Habit: In the coelom of *Leptosynapta ooplax* (MARENZELLAR)—sand-dwelling sea-cucumber.

Distribution: Tanabe Bay, Wakayama Pref. (type locality) and Mukaijima near Onomichi City, Hiroshima Pref., Honshu.

15. *Mucronalia exilis* A. ADAMS

(Pl. VI, Fig. 14)

1862 *Mucronalia exilis* A. ADAMS, Ann. Mag. Nat. Hist., (3), 9 (52), p. 295.

1863 *Leiostraca* (*Mucronalia*) A. ADAMS, Jour. Linn. Soc. London, Zool., 7, p. 91.

1929 *Mucronalia exilis* MAKIYAMA, Venus, 1, p. 168.

1944 *Mucronalia exilis* HABE, Jap. Jour. Malac. (Venus), 13 (5-8), p. 311.

1950 *Mucronalia exilis* KURODA et HABE, Illust. Cat. Jap. Shells, No. 9, p. 58, pl. 10, fig. 12.

Length 2.8 mm, breadth 1.1 mm (figured specimen collected from Suiken, Wakayama City, Honshu).

Distribution: Shimonoseki, Yamaguchi Pref. (type locality); Suiken, Wakayama City and Tanabe Bay, Wakayama Pref., Honshu.

Family STILIFERIDAE

Genus *Stilifer* BRODERIP 183216. *Stilifer ovoideus* (H. et A. ADAMS)

(Pl. VI, Fig. 18)

- 1850 *Stylifer astericola* H. A. ADAMS et REEVE, Zool. Voy. Samarang, Moll., p. 47, pl. 17, fig. 5 (non BRODERIP 1832);
 1853 *Stylifer ovoideus* H. et A. ADAMS, Gen. Rec. Moll., 1, p. 239, pl. 25, fig. 4.
 1878 *Stylifer ovoideus* SOWERBY, Conch. Icon., sp. 2.
 1884 *Stylifer ovoideus* SOWERBY, Thes. Conch., 5, p. 159, pl. 479, fig. 7.
 1886 *Stylifer ovoideus* TRYON, Man. Conch., 8, p. 290, pl. 71, fig. 39.
 1901 *Stilifer ovoideus* SOWERBY, Proc. Malac. Soc. London, 4, p. 209.
 1901 *Stylifer ovoidea* CLESSIN, Conch. Cab., 1 (28), p. 241, pl. 40, fig. 8.
 1927 *Stilifer celebensis* S. HIRASE, Nippon Dobutsu-Zukan, p. 1462.
 1932 *Stilifer celebensis* S. HIRASE, Proc. Malac. Soc. London, 20 (1), pp. 73-76, pls. 7, 8 (non KÜKENTHAL 1897).
 1933 *Stylifer celebensis* KURODA, Venus, 4 (4), p. 203.

Length 7.4 mm, breadth 5.3 mm (figured specimen collected from Tomioka, Amakusa Island, Kyushu).

Habit: In the arm of *Certionardoa semiregularis* (MÜLLER et TROSCHEL).

Distribution: Borneo (type locality); Tomioka, Amakusa, Kyushu; Kushimoto, Wakayama Pref., Misaki and Hayama, Kanagawa Pref., Honshu.

17. *Stilifer utinomii* HABE (emend.)

(Pl. VI, Fig. 22)

- 1951 *Stilifer utinomi* (sic) HABE, Illust. Cat. Jap. Shells, No. 14, p. 93 (a typographical error)
 Length 8.9 mm, breadth 5.0 mm (figured type specimen).
 Habit: In the arm of *Linckia guildingii* GRAY—Deep-sea sea-star.
 Type locality: Shirahama, Wakayama Pref., Honshu.

18. *Stilifer ophidiastericola* HABE

(Pl. VI, Fig. 19)

- 1951 *Stilifer ophidiastericola* HABE, Illust. Cat. Jap. Shells, No. 14, p. 94.
 Length 3.5 mm, breadth 2.2 mm (figured type specimen).

Habit: In the arm of *Ophidiaster cribrarium* LÜTKEN and *Ophidiaster loliori* FISHER.

Distribution: Tomioka, Amakusa, Kyushu (type locality) and Kushimoto, Wakayama Pref., Honshu.

Genus *Rosenia* SCHEPMAN 1913

19. *Rosenia castanea* (DALL)

(Pl. VI, Figs. 7, 8)

1925 *Stilifer castanea* DALL, Nautilus, 38 (3), p. 97.

1925 *Stilifer pordepressus* DALL, l. c., p. 97.

1929 *Stilifer castaneus* Is. TAKI, Venus, 1 (4), p. 116, fig. 58.

1943 *Littorina*-like form MORTENSEN, Monogr. Echinoidea, 3 (1), Camarodonta 1, p. 545.

Length 3.5 mm, breadth 3.1 mm (figured specimen collected from Emi, Chiba Pref., Honshu).

Habit: On the shell of *Pseudocentrotus depressus* (A. AGASSIZ)—littoral sea-urchin.

Distribution: Emi and Chikura, Chiba Pref.; Kurosaki, Miura Peninsula, Kanagawa Pref. and Goza, Mie Pref., Honshu.

20. *Rosenia yamamotoi* new species

(Pl. VI, Fig. 21)

Shell small, ovate, yellowish white, smooth and polished, with weak growth lines; whorls 4 in number, of which two nuclear whorls are obliquely mucronate; body whorl very large, roundly inflated, separated from the penultimate whorl by the distinctly marginated suture; aperture wide; outer margin arched, thin and sharp; columellar margin also curved, slightly thickened and dilated; umbilicus not perforated. No operculum.

Length 2.2 mm, breadth 1.7 mm (figured type specimen).

Habit: On the shell of young specimen of *Pseudocentrotus depressus* (A. AGASSIZ).

Type locality: Shisôjima, off Shirahama, Wakayama Pref., Honshu.

Remarks: This new species closely resembles *Stilifer sibogae* SCHEPMANN 1909⁷ from the East Indies, but it may be distinguished from the latter in the obliquely mucronate apex and less globular body whorl.

⁷ Siboga Exped. Monogr. 49 (2), p. 5; l. c., 49 (1), p. 241.

21. *Rosenia tokiokai* new species

(Pl. VI, Figs. 3, 12, 13)

1940 *Mucronafia* (?) sp. MORTENSEN, Monogr. Echinoidea, 3 (1), Aurodonta, p. 251, pl. 65, figs. 2, 3.

Shell ovate, semitransparent, milky white, smooth and polished; apex pointed as in *Stilifer* and coloured snowy white; whorls 9 in number, each whorl somewhat convex, suture considerably impressed; body whorl large, rounded, being contained a half of the shell length; aperture ovate; outer margin arcuate, arched forwardly; columellar margin also curved, somewhat thickened; umbilicus closed. No operculum.

Length 8.6 mm, breadth 5.2 mm (figured type specimen).

Habit: On the peristome of *Diadema selosum* (GRAY)—littoral sea-urchin.

Type locality: Shirahama, Wakayama Pref., Honshu.

Remarks: This new species is allied to *Stilifer mittrei* PETIT (1851)^{8,9} found on a Hawaiian *Diadema*, but the latter has less pointed early whorls in the young stage.

Genus *Kiramodulus* KURODA 194922. *Kiramodulus lacteus* KURODA

(Pl. VI, Figs. 1, 2)

1949 *Kiramodulus lacteus* KURODA, Jap. Jour. Malac. (Venus), 15 (5-8), pp. 72-75, fig. 1.

Length 6.3 mm, breadth 7.6 mm (figured type specimen).

Habit: On the arm of a deep-sea sea-star, probably belonging to *Paragonaster* or *Perissogonaster* (according to the identification by Dr. R. HAYASHI).

Type locality: Tosa Bay, Shikoku.

Remarks: The systematic position of this genus and species was quite obscure at its establishment, but later the original author (1950)¹⁰ noticed the fact that the protoconch of this species is *Stilifer*-like, quite characteristic in gastropods. I also could confirm that the animal of this species has no radula. Thus I think that this genus should be placed in the family Stiliferidae.

8) Jour. de Conchyl., 2, p. 27, pl. 2, figs. 8, 9.

9) PILSBRY 1920, Proc. Acad. Nat. Sci. Phila., 72, p. 298, figs. 2a, b.

10) Yumehamaguri, no. 51, p. 79, textfig. (a mimeographed journal).

Parasitic Gastropods Found in Echinoderms

Incertae sedis

23. "*Eulima*" sp.

1921 *Melanella* sp. A. H. CLARK, Monogr. Exist. Crinoids, 1, Comatulids 2 (U. S. Nat. Mus., Bull. 82), p. 649.

1927 *Eulima* sp. GISLÉN, Vid. Medd. Dansk Naturh. Foren. København, 83, p. 40.

1950 *Eulima* sp. A. H. CLARK, Monogr. Exist. Crinoids, 1, Comatulids 4c, p. 20.

Habit: On the arm of *Stenometra diadema* (A. H. CLARK).

Distribution: Off Kyushu (lat. 32°17'N., long. 128°11'E.), 201 m; southern Japan, from 80 to 170 fathoms.

24. "*Eulima*" sp.

1922 *Eulima* sp. GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, (4) 5, p. 94.

1947 *Eulima* (probably *Sabinella* or *Melanella*) sp. A. H. CLARK, Monogr. Exist. Crinoids, 1, Comatulids 4b, p. 373.

Habit: On the arm of *Neometra multicolor* (A. H. CLARK).

Locality: Goto Islands, Kyushu, 164 m.

25. "*Mucronalia*" sp.

1943 *Mucronalia* (?) sp. MORTENSEN, Monogr. Echinoidea, 3 (2), Camarodonta 1, p. 251.

Habit: On the young specimen of *Temnotrema sculptum* A. AGASSIZ.

Locality: Mutsu Bay, Honshu.

26. "*Mucronalia*" sp.

1943 *Mucronalia* (?) sp. MORTENSEN, *l. c.*, p. 251.

Habit: On *Temnotrema sculptum* A. AGASSIZ.

Locality: Off Okino-shima, Kyushu.

27. "*Stilifer*" sp.

1917 *Stylifer*-like sp. MATSUMOTO, Monograph of Japanese Ophiuroidea (Journ. Coll. Sci. Imp. Univ. Tokyo, 38, p. 222.

Habit: At the genital slits of *Ophiothrix macrobrachia* CLARK.

Locality: Sagami Sea and Uruga Channel.

Family PAEDOPHOROPIDAE

Genus *Paedophoropus* IWANOFF 193328. *Paedophoropus dicoelobius* IWANOFF

1933 *Paedophoropus dicoelobius* IWANOFF, Zool. Anz., 104, pp. 161-165.

Habit: In the polian vesicle of *Eupyrgus pacificus* ÖSTERGREN—deep-sea sea-cucumber.

Locality: Japan.

Family ASTEROPHILIDAE

Genus *Asterophila* RANDALL et HEATH 191229. *Asterophila japonica* RANDALL et HEATH

1912 *Asterophila japonica* RANDALL et HEATH, Biol. Bull., 22, pp. 98-103, pls. 1 & 2.

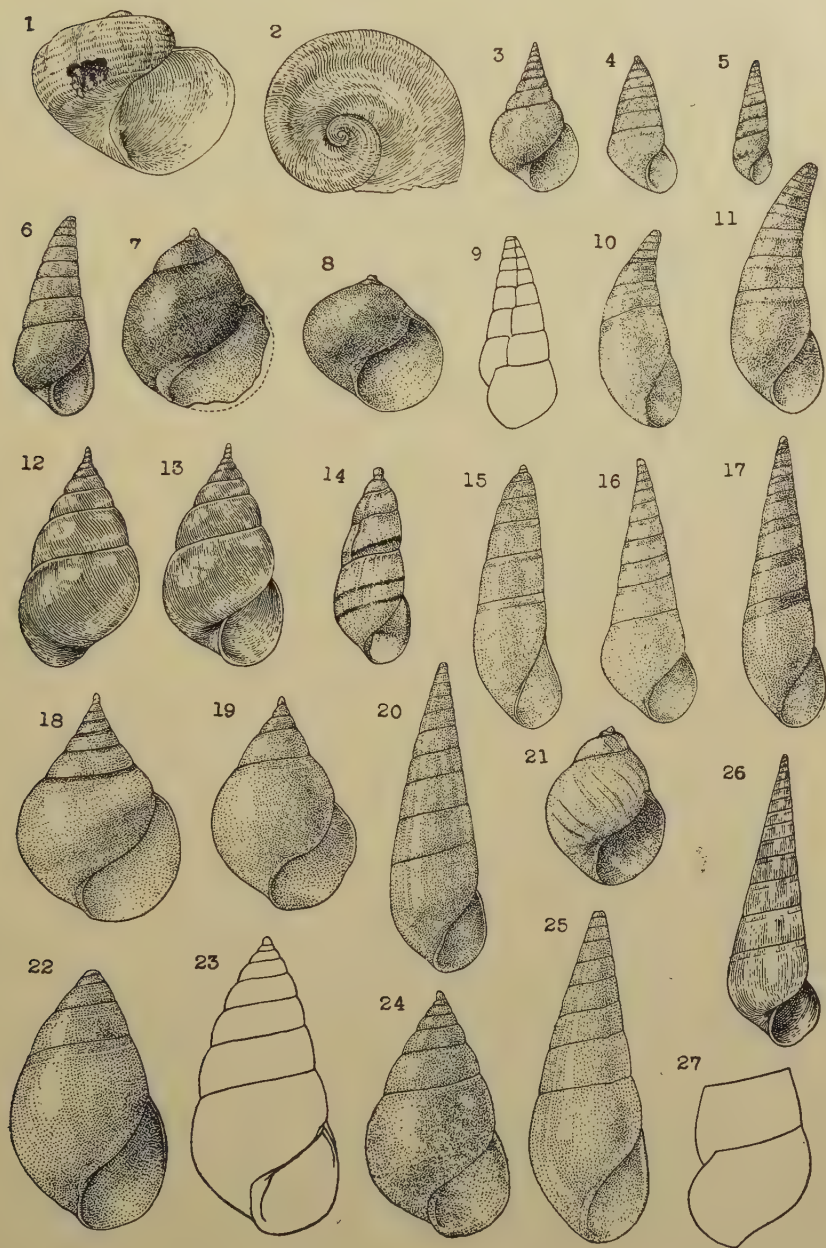
Habit: In the coelom of the arm of *Pedicellaster* (= *P. magister orientalis* FISHER)—sea-star.

Locality: Off the coast of Corea, 150-163 fathoms. (Albatross Stations 4861-4867).

EXPLANATION OF PLATE VI

(Each figure is unequally magnified.)

- Figs. 1, 2. *Kiramodulus lacteus* KURODA (type specimen) (6.3 mm × 7.6 mm)
3. *Rosenia tokiokai* n. sp. (6.0 mm × 3.6 mm)
4. *Balcis robustus* (A. ADAMS) (4.8 mm × 2.4 mm)
5. *Balcis akauni* n. sp. (type specimen) (4.6 mm × 1.5 mm)
- 6, 9. *Balcis yamazii* n. sp. (type specimen) (7.5 mm × 3.1 mm)
7. *Rosenia castanea* (DALL) (3.5 mm × 3.1 mm)
8. *Rosenia castanea* (DALL) (*perdepressus*-form) (2.8 mm × 2.8 mm)
10. *Balcis komaii* HABE (type specimen) (4.1 mm × 1.9 mm)
11. *Balcis auratus* (S. HIRASE) (4.0 mm × 1.5 mm)
- 12, 13. *Rosenia tokiokai* n. sp. (type specimen) (8.6 mm × 5.2 mm)
14. *Mucronalia exilis* (A. ADAMS) (2.8 mm × 1.1 mm)
15. *Mucronalia lactea* (A. ADAMS) (4.8 mm × 1.8 mm)
16. *Balcis astropectenicola* KURODA et HABE (type specimen) (7.2 mm × 2.4 mm)
17. *Balcis peronellicola* KURODA et HABE (type specimen) (4.3 mm × 1.5 mm)
18. *Stilifer ovoideus* (H. et A. ADAMS) (7.4 mm × 5.3 mm)
19. *Stilifer ophidiastericola* HABE (type specimen) (3.5 mm × 2.2 mm)
20. *Balcis kuronamako* n. sp. (type specimen) (8.3 mm × 2.8 mm)
21. *Rosenia yamamotoi* n. sp. (type specimen) (2.2 mm × 1.7 mm)
22. *Stilifer utinomii* HABE (type specimen) (8.9 mm × 5.0 mm)
23. *Stilapex philippinarum* (SOWERBY) (10.4 mm × 5.3 mm)
24. *Stilapex philippinarum* (SOWERBY) (9.8 mm × 4.8 mm)
25. *Balcis soliduloides* HABE (type specimen) (7.5 mm × 2.8 mm)
- 26, 27. *Balcis teramachii* n. sp. (type specimen) (8.2 mm × 2.6 mm)



T. HABE: PARASITIC GASTRÓPODS FOUND IN ECHINODERMS.

OBSERVATIONS ON THE SPAWNING HABITS OF SOME OF THE JAPANESE OPISTHOBRANCHIA (1)*

KIKUTARÔ BABA and IWAO HAMATANI

Biological Laboratory, Osaka University of Liberal Arts

With Plate VII and 3 Text-figures

The aim of this paper is to deal with the spawning habits of some of the Japanese Opisthobranchia as they are seen in the field as well as in the laboratory aquarium. Taking this opportunity, we wish to thank to Drs. Huzio UTINOMI and Takasi TOKIOKA whose kind permission enabled us to work at the Seto Marine Biological Laboratory, and to Dr. Masao SUGIYAMA who has allowed us to use the equipments of the Sugashima Marine Biological Laboratory for our study. Parts of the observations were also carried out at our University laboratory, the fresh material of the opisthobranchs being brought back from the various parts of the Osaka Bay. The present study was commenced in the winter of 1950.

1. *Stiliger* (*Stiliger*) *boodlea* BABA

(Fig. 1)

References to the species: BABA 1938, pp. 7-8, figs. 4-5; BABA 1949, p. 31, pl. 7, fig. 21, text-fig. 17.

This species is a constant visitor to the coast around the Seto Marine Biological Laboratory. During the months of winter, the tiny black animals come ashore and usually tend to congregate in considerable numbers on the green algae such as *Boodlea coacta* and *Enteromorpha* sp. which grow in the rock pools of high tide level.

For laboratory work, we collected the same species from the shore of Tannowa, Osaka Bay. There the animals are frequent in the *Enteromorpha* zone and lay eggs, the spawning period lasting from November to March. The egg-

* Contributions from the Seto Marine Biological Laboratory, No. 179.

masses thus deposited on the leaves of *Enteromorpha* are usually in the form of a long and flattened ribbon, diminishing in size towards the end. They vary from 2-7 mm in total length, and somewhat curved to one side. The individual egg is densely yellow-yolked. Only one egg is contained in each

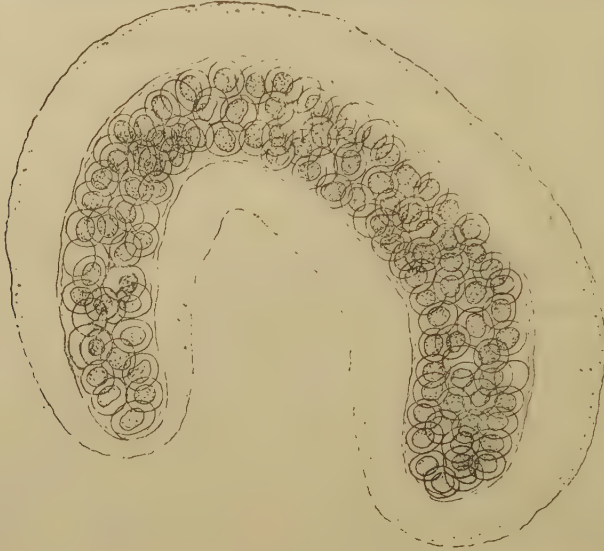


Fig. 1. *Stiliger boodleae*. A complete egg ribbon (Tannowa, Nov. 27, 1950). $\times 80$.

2. *Stiliger (Stiliger) berghi* BABA

(Fig. 2; Pl. VII, Figs. 1-2)

Reference to the species: BABA 1937, pp. 222-223, pl. 4, fig. 7, text-fig. 8.

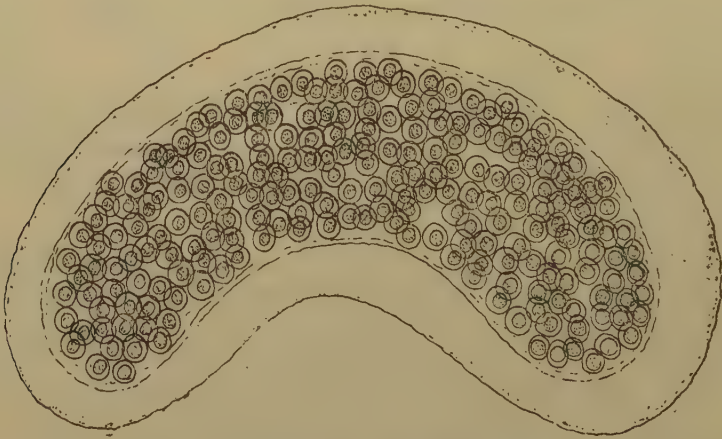


Fig. 2. *Stiliger berghi*. A complete egg ribbon (Tannowa, Mar. 13, 1951). $\times 25$.

capsule and the capsules are bound together by a gelatinous matrix. In captivity the spawning of this species has taken place usually in the night before sunrise.

The specimens of this small-sized species were collected from Tannowa, Osaka Bay, from among the delicate branches of the brown algae in shallow water. They spawned frequently in our laboratory aquarium in March.

The egg-masses we obtained are all shaped roughly as in the preceding species, but the individual eggs have no colours. The maximum size of the egg-masses in question is about 4 mm long by 1 mm broad.

3. *Hermaea dendritica* (ALDER & HANCOCK)

(Fig. 3; Pl. VII, Figs. 3-7)

References to the species: BABA 1937, pp. 223-224, pl. 4, fig. 8, text-fig. 9; BABA 1950, p. 1077, fig. 3052.

This species is fairly common on *Codium contractum* and *Bryopsis plumosa* in shallow water surrounding the Sugashima Marine Biological Laboratory. Our specimens collected alive from the sea have laid eggs in May.

The eggs are opaque, colourless, protected each by a capsule, and are thickly connected together in the form of an irregularly curved string, more than 25 mm in total length. One individual is able to spawn repeatedly. As it repeats spawning acts within a given length of time, the last strings of eggs become naturally much shortened. The gelatinous matrix which covers the whole eggs is extremely viscid and serves to fasten the string to any object.



Fig. 3. *Hermaea dendritica*.
A somewhat fragmental string of eggs (Sugashima, May 25, 1951). $\times 10$

4. *Goniodoris glabra* BABA

(Pl. VII, Figs. 8-11)

References to the species: BABA 1937, pp. 294-295, pl. 1, fig. 5; BABA 1949, pp. 46-47, pl. 15, fig. 54, text fig. 47.

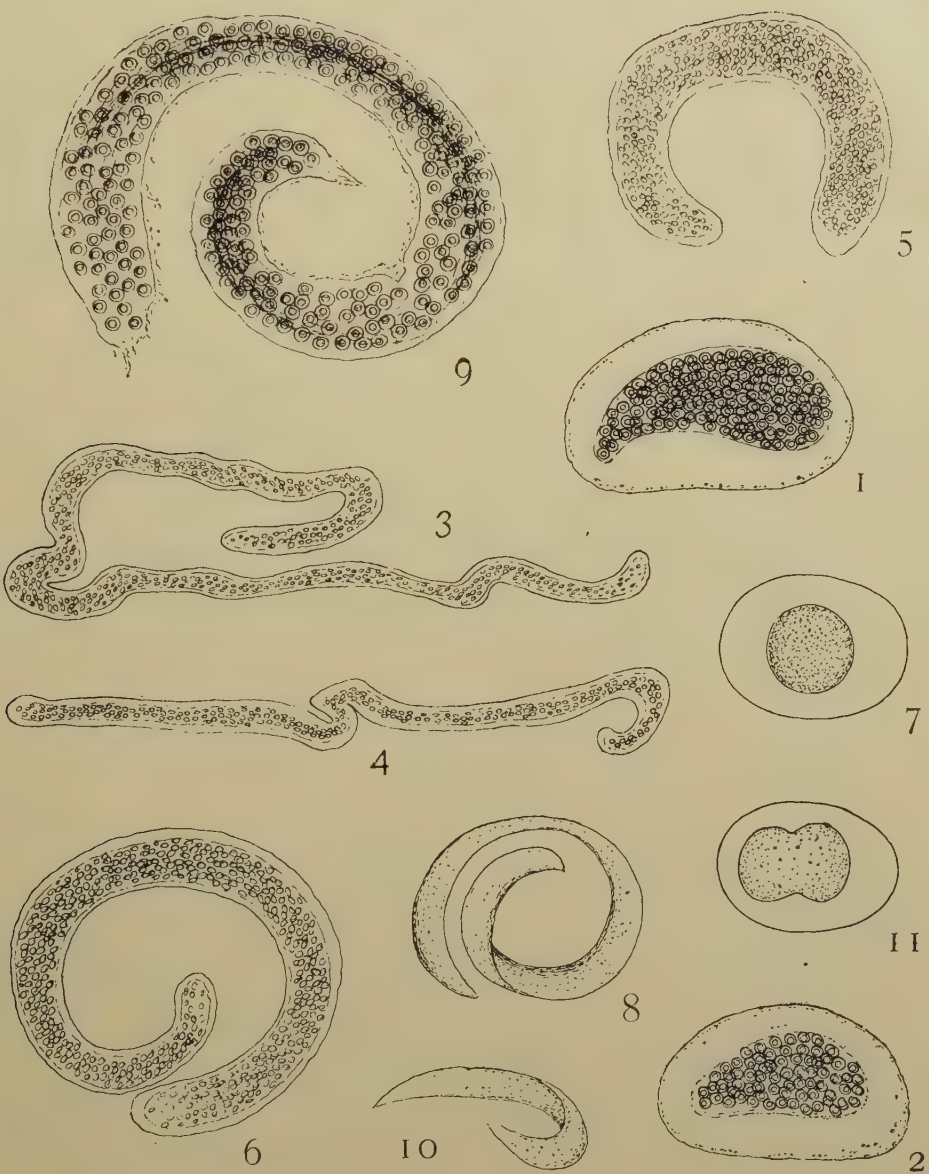
The spawning of this species was observed at the Seto Marine Biological Laboratory late in May. Typically the egg mass is deposited in the form of a spiral ribbon fastened in about $1\frac{1}{2}$ convolutions to the substratum. It measures ca. 5 mm in diameter in surface view of the whole mass. The capsules within the ribbon contain only one egg each. The latter is densely yolk-laded, and is tinged with vivid orange-yellow.

REFERENCES

- BABA, K. 1937 Opisthobranchia of Japan (I, II). Journ. Dept. Agric. Kyūshū Imp. Univ., vol. 5, nos. 4, 7.
 ——— 1938 Opisthobranchia of Kū, Middle Japan. Journ. Dept. Agric. Kyūshū Imp. Univ., vol. 6, no. 1.
 ——— 1949 Opisthobranchia of Sagami Bay. Iwanami Shoten, Tōkyō.
 ——— 1950 Illustrated encyclopedia of the fauna of Japan, revised edition. Mollusca. Hoku-ryūkan, Tōkyō.
 O'DONOGHUE, C. H. & O'DONOGHUE, E. 1922 Notes on the nudibranchiate mollusca from the Vancouver Island Region. II. The spawn of certain species. Trans. Roy. Canad. Inst., vol. 14.

EXPLANATION OF PLATE VII

- Figs. 1-2. *Stiliger berghi*. Two fragmental ribbons of eggs (Tannowa, Mar. 13, 1951). $\times 20$.
 Figs. 3-7. *Hermaea dendritica*.
 3-4. Typical egg-strings (Sugashima, May 6, 1951). $\times 3$.
 5-6. Somewhat fragmental egg-strings (Sugashima, May 25, 1951). $\times 7$.
 7. An egg-capsule within the egg-string. $\times 180$.
 Figs. 8-11. *Goniodoris glabra*.
 8. A complete egg ribbon in surface view (Seto, June 22, 1951). $\times 6$.
 9. The same, more highly enlarged. $\times 12$.
 10. A somewhat incomplete egg-ribbon in surface view (Seto, June 22, 1951). $\times 6$.
 11. An egg-capsule within the egg-ribbon. $\times 50$.



K. BABA & I. HAMATANI: SPAWNING HABITS OF OPISTHOBRANCHIA (I)

ASCIDIANS COLLECTED BY MESSRS. RENZI WADA AND
SEIZI WADA FROM THE PEARL-OYSTER BED IN
THE ARAFURA SEA IN 1940*

TAKASI TOKIOKA

Seto Marine Biological Laboratory, Sirahama

With 29 Text figures

The present material consists of 27 species collected by Mr. RENZI WADA of the former Nan'yô Pearl Company and Mr. SEIZI WADA, an associate of the former Palao Tropical Biological Station, from the pearl-oyster bed off Melville in the Arafura Sea during the period from September to November of 1940. I express here my hearty thanks to Messrs. R. WADA and S. WADA for their kindness in offering me the present precious material. I am also very grateful to Prof. T. KOMAI for his kind guidance and incessant encouragement. The present work is a part of the study progressed by the financial aid from the Ministry of Education.

1. *Didemnum (Polysyncraton) arafurensis* n. sp.

(Fig. 1)

Two colonies collected by Mr. R. WADA. One is 30 mm long $\times$ 10-15 mm wide in extent and 1 mm in thickness. The other is very small, only 5 mm $\times$ 5 mm in extent and 1-1.5 mm in thickness. Test white and covered densely with spicules which are rather small, less than 70μ , consisting of many rays pointed acutely, and distributed densely and evenly throughout the test. On the larger colony, spicules are rather sparse at the position where each zooid is situated. Cloacal aperture indistinct. Buds of the thorax and abdomen on the oesophagus.

Zooid: Colourless in the preserved state. Large zooids reach 1.2 mm in length, thorax as long as abdomen. Branchial aperture 6-lobed; atrial aperture a huge opening, extending from the dorsal ganglion to the anus and

* Contributions from the Seto Marine Biological Laboratory, No. 180.

ventrally near the endostyle and provided with a short atrial languet ending in some zooids in two small lappets.

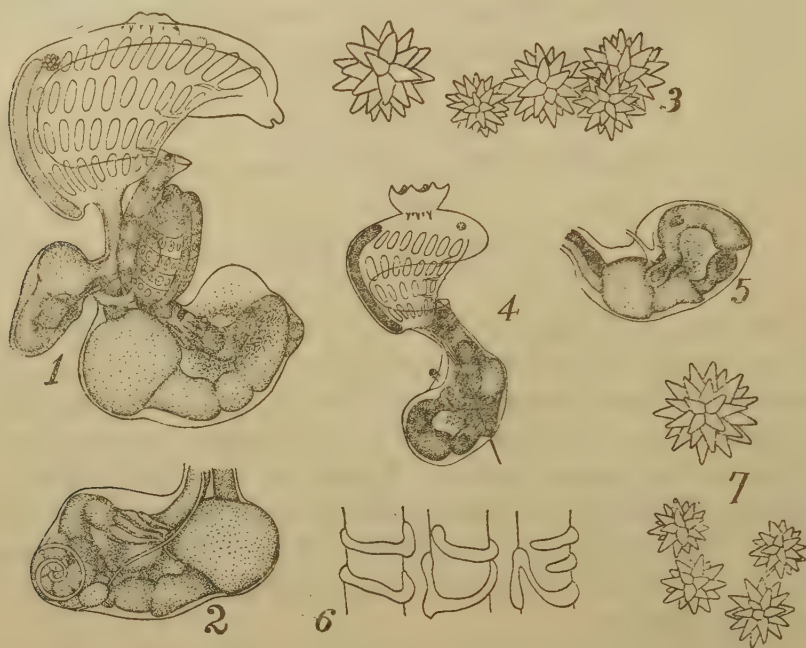


Fig. 1. *Didemnum (Polysyncraton) arafurensis* n. sp. 1-3 Large colony, 1—Zooids $\times 45$, 2—Abdomen $\times 45$, 3—Spicules $\times 200$, 4-7 Small colony, 4—Zooid $\times 45$, 5—Abdomen $\times 45$, 6—Circum-intestinal gland, 7—Spicules $\times 200$.

Thorax: Branchial sac with 4 stigmata-rows, each with 6-7~9-10 stigmata. Dorsal languet distinct. Tentacles 12, 6 larger and 6 smaller. A thoracic organ, indicated by a small calcareous agglomerate, at the antero-ventral side of the atrial aperture on each side in some zooids of the larger colony.

Abdomen: Alimentary canal as in usual members of Didemnidae. Anus with two lobules. Testicular follicles up to 6, vas deferens coils $2\frac{1}{2}$ times in not fully mature state. Circumintestinal gland is consisting of several finger-shaped blind sacs in zooids of the larger colony, while it is composed of two or three tubules surrounding the intestine in zooids of the smaller colony.

2. *Leptoclinides rufus* (SLUITER) 1909

(Fig. 2)

Polysyncraton rufum; SLUITER (1909): Siboga-Exped., Monogr. LVI b, pp. 72-73, Pl. IV fig. 5.

SLUITER (1914): Abhandl. Senckenberg. Naturforsch. Gesell., Bd. 45, Hft. 1, p. 77.

? *Leptoclinides diemensis*; MICHAELSEN (1924): Vid. Medd. fra Dansk nat. Foren., Bd. 77, pp. 331-336, Fig. 12.

? *Leptoclinides lissus*; HASTINGS (1931): Great Barrier Reef Exp., Vol. IV., No. 3, pp. 93-94, Fig. 12.

A colony found by Mr. R. WADA encrusting the shell of a pearl oyster. It is 70 mm×25-30 mm in extent and 1.5-2 mm in thickness. Test semitransparent and sparsely sprinkled with minute calcareous spicules which are smaller than 80 μ and distributed rather evenly throughout the test, although they are slightly denser around the branchial apertures. The tip of each ray pointed very sharply. Zooids aggregated so as to form many small groups.

Zooids: Colourless in the preserved state, except ova which are somewhat yellowish. Large individuals reach 1.5-2.0 mm in length, abdomen slightly larger than thorax. Branchial aperture 6-lobed, atrial siphon short.

Thorax: About eight longitudinal muscular bands on each side of the thorax. Stigmata rows 4, each consisting of ca. 9 stigmata. Tentacles 12, 6 larger and 6 smaller. Dorsal languets of moderate size. Thoracic organ at each lateral side of the posterior part of the thorax. Each organ contains a calcareous aggregate in that structure. Anus bilobed and opening at the postero-dorsal corner of the thorax.



Fig. 2. *Leptoclinides rufus* (SLUITER). 1—A branchial aperture×45, 2—Zooid×45, 3—Anus, 4—Abdomen×75, 5—Abdomen with buds×75, 6—Spicules×200.

Abdomen: Testicular follicles 4, vas deferens coils $8\frac{1}{2}$ ~ $9\frac{1}{2}$ times in mature state. Buds of thorax pyloric; usually two in number, although in some rare cases 4 small buds may be observed. Buds of abdomen oesophageal? and usually several in number.

Remarks: Evidently the present specimen belongs to the group of *L. dubius* (SLUITER) and its allies. Among this group, *Polysyncraton rufus* SLUITER, *L. diemensis* MICHAELSEN and *L. lissus* HASTINGS resemble the present form most closely. The number of the testicular follicles in this specimen is nearest to that of *L. diemensis*, but I prefer to adopt the oldest name of these three species, *L. rufus*, for the present specimen, since I can not discern any fundamental difference between these three species.

3. *Leptoclinides dubius* (SLUITER) 1909

(Fig. 3)

Polysyncraton dubium; SLUITER (1909): Siboga-Exped., Monogr. LVI b, pp. 69-71, Pl. IV, fig. 3, Pl. VII, fig. 10.

VAN NAME (1918): U. S. Nat. Mus., Bull. 100, Vol. 1, Part 2, pp. 155-159, Figs. 107 & 108.

HARTMEYER (1919): Kungl. Sv. Vetens. Handl., Bd. 60, No. 4, pp. 136-144.

A large colony, 115 mm×30 mm in extent and 1.5-2.0 mm in thickness, was found by Mr. R. WADA. It is white in colour on account of the existence of small calcareous spicules which are distributed very densely and evenly throughout the whole layers of the colony. They are smaller than 27μ in diameter and composed chiefly of truncate rays, although a small part of them are consisting of sharply pointed rays. Spicules with truncate rays: spicules with pointed rays is about 8:1. Many small elevations of these spicules are found on the surface of the colony. The margin of the colony is extremely thin and forms irregular lobes. Cloacal apertures found sparsely; they are small and round? in outline.

Zooïd: Colourless in the preserved specimen. Zooïds scarcely reach 2 mm, usually less than 1.7 mm in length. Thorax is nearly as long as abdomen. Branchial aperture 6-lobed.

Thorax: About 8 longitudinal muscular bands on each side of the thorax. Branchial sac with 4 rows of stigmata, each consisting of 11-13 elongate stigmata. Tentacles 12, 6 larger and 6 smaller. Dorsal languets slightly displaced on the left side from the dorso-median line. Ciliated groove a round orifice. A round thoracic organ on each side of the thorax near the anus which opens

at the postero dorsal corner of the thorax and with two lobules.

Abdomen: Rectum crooked sharply at the level of the halfway of the middle-intestine. Circum-intestinal gland distinct, being composed of ca. 10 finger-shaped blind sacs. Gonad not found in any zooid. Many round bodies (Fig. 3-6) are found in the colony. They are considered as liberated thorases from old zooids, new thorases of which develop from outgrown buds on their oesophagus? as shown in my previous article (1949) on *L. komaii*. These bodies seem to be in a resting state before regeneration.



Fig. 3. *Leptoclinides dubius* (SLUITER). 1—Zooid $\times 45$, 2—Abdomen $\times 45$, 3—Tentacles $\times 110$, 4—Ciliated groove and dorsal languets $\times 110$, 5—Circum-intestinal gland, 6—Resting thorax before regeneration $\times 45$, 7—Spicules $\times 200$.

Remarks: The shape of the calcareous spicules and the sharply crooked appearance of the rectum place the present specimen near *Polysyncraton dubium*, a Siboga species reported from the Siboga area and from the Philippines. It is, however, not impossible that the preceding species is not a distinct species but merely a form of the present species.

4. *Polycitor renzi-wadai* n. sp.

(Fig. 4)

A roughly spherical mass, 20 mm long $\times$ 15 mm wide $\times$ 17 mm high, was found by Mr. R. WADA. The basal portion of the colony spreads out slightly and adheres to the substratum by this area. Test cartilaginous, milky white in colour and semitransparent; the surface smooth and without any foreign matter, but merely a little amount of sand grains.

Zooid: Less than 7 mm in length. Abdomen one and half times the length of the thorax. Both apertures 6-lobed.

Thorax: About 20 thin longitudinal muscular bands on each side of the thorax. Branchial sac with 15-20 stigmata rows. Anus opens near the posterior end of the thorax. Two tentacular rings are observable. The anterior one consisting of 6 small tentacles, while the posterior one consisting of 6 larger tentacles. Dorsal languets distinct. Ciliated groove a longitudinal slit.

Abdomen: A pair of longitudinal muscular bands run along the ventro-sinistral side of the abdomen. Stomach situated slightly behind the half-way of the abdomen and provided with 7-8 plications on each side. The junction between the rectum and the mid-intestine is constricted

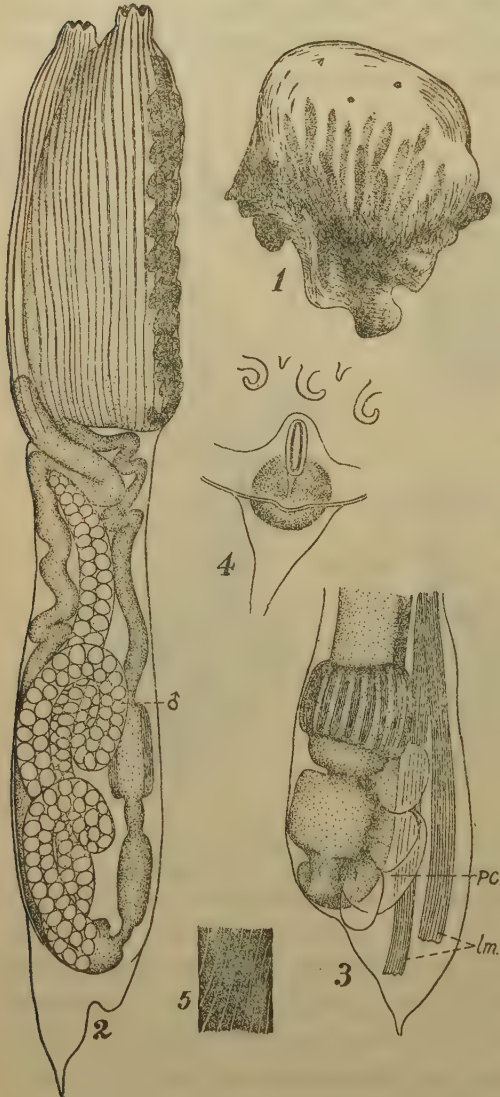


Fig. 4. *Polycitor renzi-wadai* n. sp. 1—Entire colony, 2—Zooid, 3—Abdomen, 4—Ciliated groove $\times 45$, 5—A part of the intestinal plication. pc.—Pericardium, lm—Longitudinal muscle band.

very prominently. Consequently the proximal portion of the rectum form a sort of indistinct coeca. Fifteen-twenty faint intestinal plications are found along the rectum, starting from the proximal portion and extending for a considerable distance. Only the male gonad was observed in some examined zooids. In mature state, a thick tube, filled with many small testicular follicles, run sinuously in the loop of the alimentary canal.

Remarks: The present new species resembles closely *P. aurantiacus* (HERDMAN) in having many stigmata-rows on the branchial sac, but differs distinctly from the latter in the appearance of the stomach, the wall of which in the latter is nearly smooth, but with many faint papillae arranged in a net-work.

5. *Clavelina* (*Synclavella*) *arafurensis* n. sp.

(Fig. 5)

A colony consisting of about a dozen elongate cormidia was found by Mr. S. WADA. Each cormidium contains about a dozen zooids and may reach 23 mm in length and 6 mm in diameter in maximum. Corona, the distal part of the cormidium, is very soft and easily mutilated, while the peduncular and basal portions are considerably hard, semitransparent and faintly pinkish in colour.

Zooid: Large zooids reach 16 mm in length and light red in colour. Abdomen one and a half times the length of the thorax. Both branchial and atrial apertures plainly margined or faintly 6-lobed?

Thorax: Transverse muscular bands rather distinct. Branchial sac with 16 stigmata-rows, each row consisting of ca. 20 stigmata. Tentacles 32; 8 large, 8 moderate and 16 small ones are arranged roughly in two circles. Ciliated groove a longitudinal slit. Dorsal languets somewhat triangular in shape. Anus bilobed and situated at the dorso-posterior corner of the thorax.

Abdomen: Stomach near the posterior end of the abdomen, with 5-6 ? plications running longitudinally on the right side and those of the same number arranged somewhat obliquely on the left side. The mid-intestinal portion is present, but not remarkable. Gonad near the posterior end of the loop of the alimentary canal. A pair of longitudinal muscular bands along the left side.

Remarks: The appearance of the colony and the shape of the cormidium are the characteristics of the present new species.

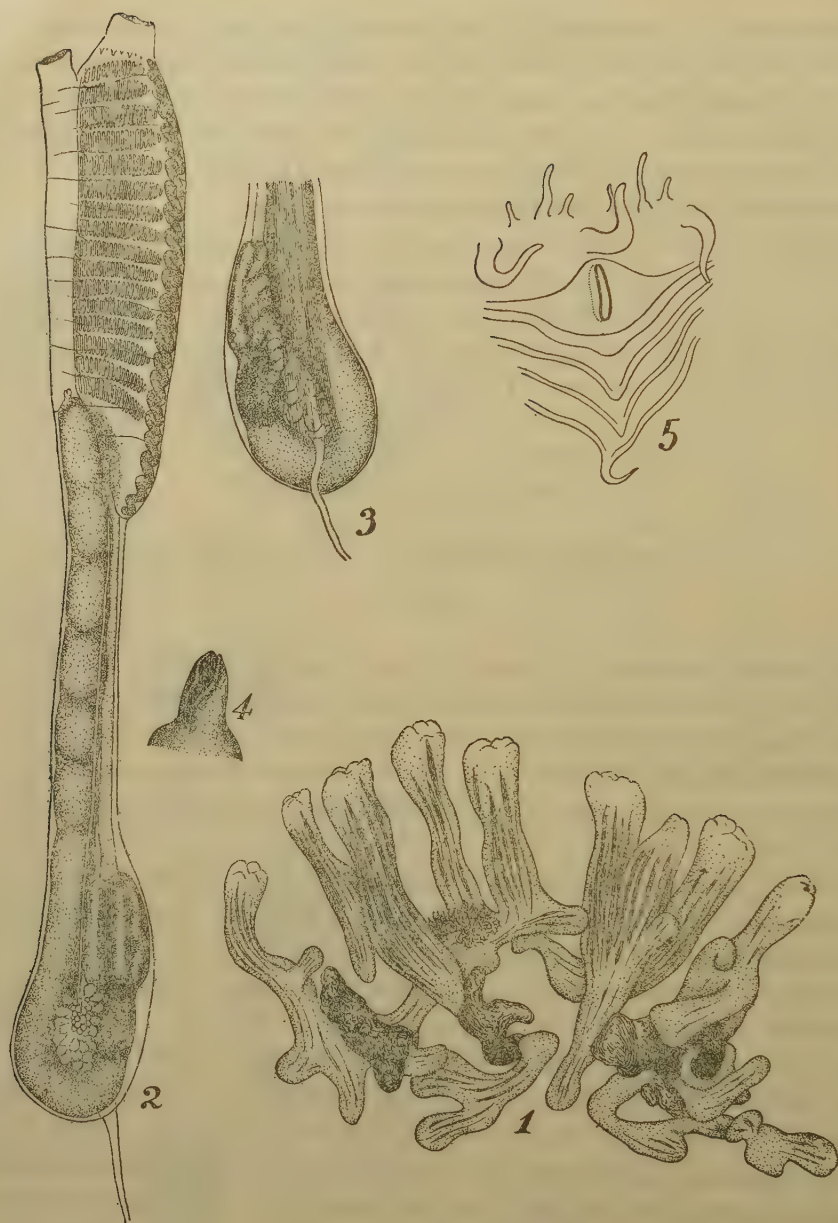


Fig. 5. *Clavelina* (*Synclavelina*) *arafurensis* n. sp. 1—Entire colony, 2—Zooid, right side $\times 12$; 3—Posterior part of abdomen, left side $\times 12$; 4—Anus, 5—Tentacles, ciliated groove and dorsal languets $\times 45$.

6. *Sycozoa seizi-wadai* n. sp.

(Fig. 6)

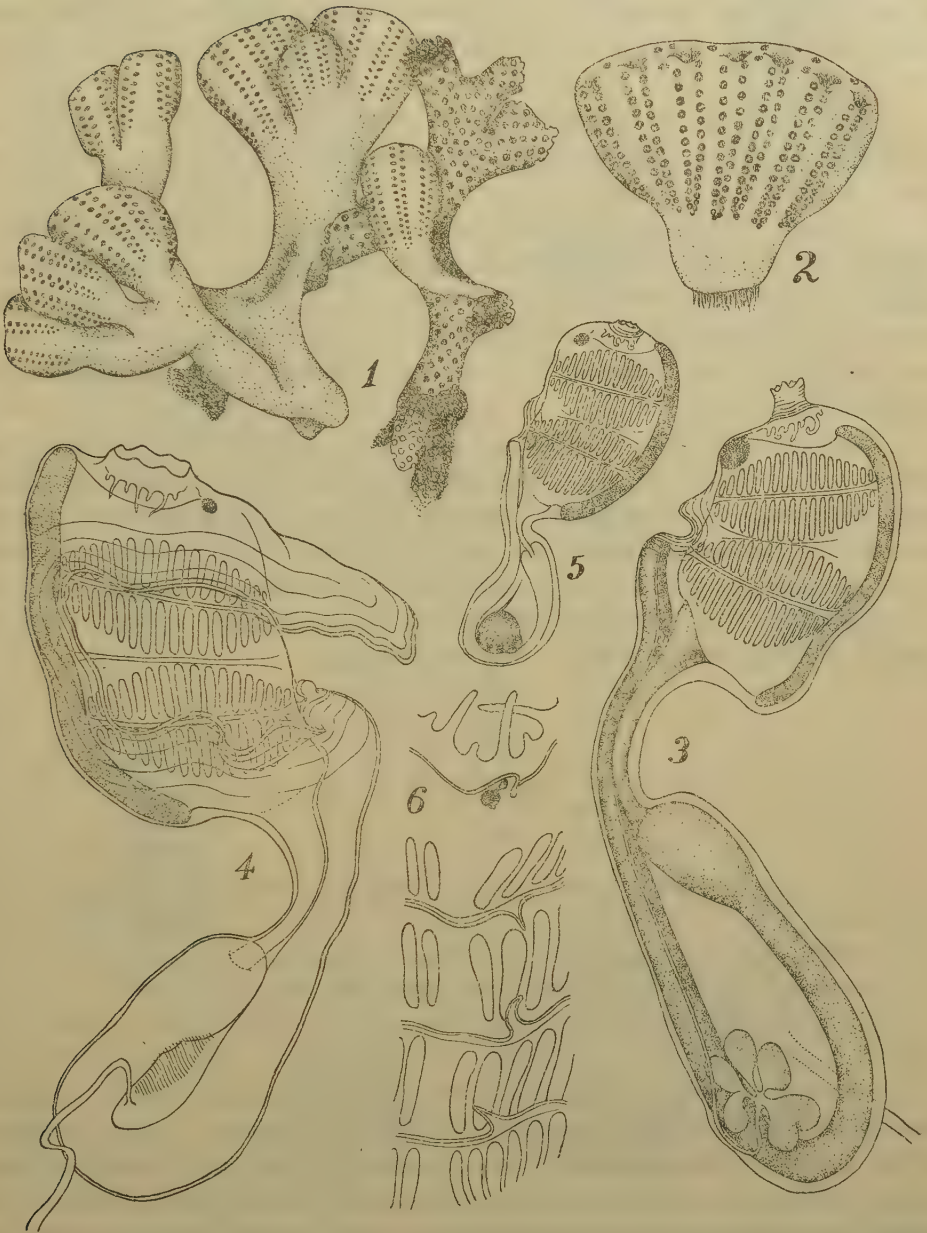


Fig. 6. *Sycozoa seizi-wadai* n. sp. 1—Entire colony $\times 1$, 2—A cormidium, enlarged; 3—A sinistral zooid, right side $\times 45$; 4—A sinistral zooid, left side $\times 45$; 5—A young zooid $\times 45$, 6—Tentacles and dorsal languets $\times 45$.

One colony consisting of 9 cormidia was found by Mr. S. WADA. The largest cormidium 24 mm wide $\times$ 12 mm high and 6 mm in thickness. Test semi-transparent and sprinkled with many milky white flecks on the distal parts of some cormidia. Pinkish in life? Zooids arranged in paired rows as shown in Fig. 6-1 and 2. Cloacal aperture at the distal end of each pair of vertical rows.

Zooid: Zooids are colourless in the preserved state and less than 3 mm in length. In fully grown zooids, the abdomen is larger than the thorax. Branchial aperture 5-6 lobed.

Thorax: Thoracic muscular bands very weak. Branchial sac with 4 stigmata-rows, each row consisting of ca. 15-20 stigmata. Tentacles 12, consisting of larger and smaller ones. Ciliated groove a minute orifice. Dorsal languets displaced slightly to the left side from the dorso-median line. Anus with two lobules and situated at the level between the third and fourth stigmata-rows.

Abdomen: Loop of alimentary canal rather simple. Stomach near the mid-way of the abdomen and constricted off distinctly from the oesophagus, while it tapers posteriorly to the intestine without forming any mid-intestinal portion. In the present colony, no zooid was found with the ovary. Testis in the posterior part of the intestinal loop and consisting of several follicles.

Remarks: The shape of the cormidium and consequently that of the colony are the characteristics of this new species.

7. *Nephtheis fascicularis* (DRASCHE) 1882

(Fig. 7)

Colella thomsoni: HERDMAN (1886): Rep. Voy. Challenger, Vol. 14, Tunicata, pp. 94-103, Pl. X-XIII.

Nephtheis thomsoni; SLUITER (1909): Siboga-Exped., Monogr. 56 b, p. 36.

HARTMEYER (1919): Kungl. Sv. Vetensk. Handl., Bd. 60, No. 4, p. 121.

Nephtheis thompsoni; VAN NAME (1918): U. S. Nat. Mus. Bull. 100, Vol. 1, Part 2, pp. 144-147, Fig. 96.

Three colonies were available to the present description. Two of them were collected by Mr. R. WADA at the "Zyûmonzi" (=Cross) Reef off Melville on Oct. 22, 1940. One consisting of 30 mm long cormidium and 50 mm long peduncle and matured sexually; the other consisting of 18 mm long cormidium and 30 mm long peduncle and sexually immature. One of the three was found by Mr. S. WADA. It is 19 mm in length of cormidium, 34 mm in length of peduncle and matured sexually. Test of the cormidium transparent and gelatinous.

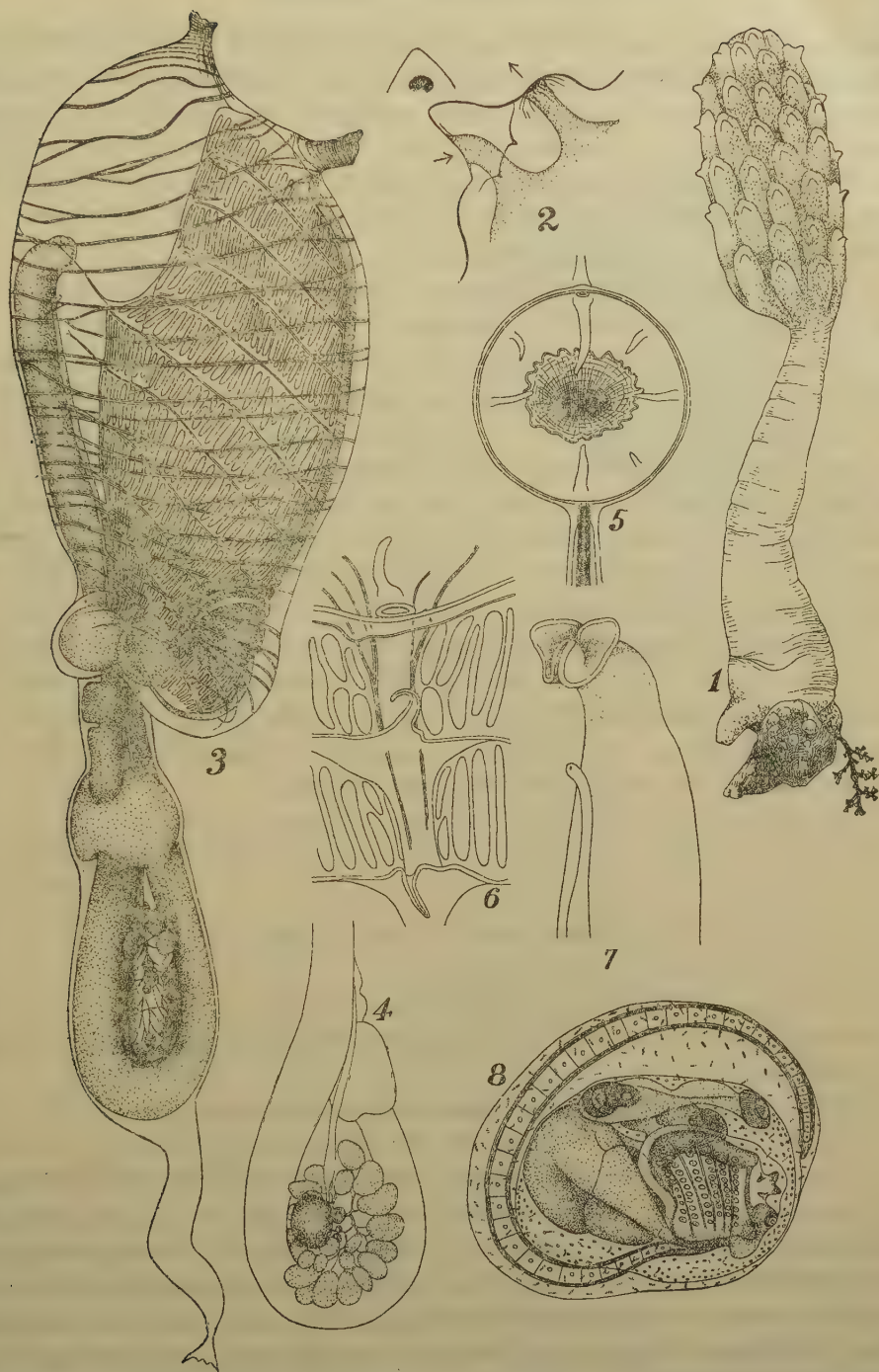


Fig. 7. *Nephtheis fascicularis* (DRASCHE). 1—A colony $\times$ ca. 1, 2—Situation of apertures, 3—Zooid, right side $\times$ 10; 4—Abdomen, left side $\times$ 10; 5—Tentacles, 6—Ciliated groove and dorsal languets $\times$ 40, 7—Anus $\times$ 42; 8—Larva $\times$ 40.

Peduncle somewhat hard and with some hydrozoans and didemnids etc. on the surface. The smallest colony consisting of ca. 30 zooids, while two other colonies are composed of many zooids arranged roughly in 9 rows, each of which consisting of 7-9 zooids. Branchial aperture opens on each posterior side of the conical protuberances projecting out from the surface of the test. Both apertures faintly divided each in 4 lobes, of which the dorsal-most one of the branchial aperture is the largest.

Zooid: Colourless in the preserved state. Large zooids reach 10 mm in length. Thorax larger than the abdomen.

Thorax: Transverse muscular bands very distinct. The branchial sac with 11-12 stigmata-rows. Tentacles typically 8; 4 larger and 4 smaller ones, of which usually a smaller one is deficient. Ciliated groove a minute oval opening. Dorsal languets nearly on the dorso-median line. Anus bilobed and situated at the level between the fifth and sixth stigmata-rows. Embryos up to 6 in the incubatory chamber on the right posterior side of the thorax. Trunk of larva is fairly shorter antero-posteriorly than dorso-ventrally. Attachment organs well developed and situated in a triangle.

Abdomen: Oesophagus has a small swelling on its way to the stomach which is situated in the anterior half of the abdomen, roughly spherical in shape and with smooth surface. Mid-intestine quite obsolete. Gonad in the loop of the alimentary canal. Testis consisting of follicles of a considerable number. Ovary situated at the centre of the testis.

8. *Perophora listeri* FORBES & HANLEY 1848

(Fig. 8)

Perophora listeri; ALDER & HANCOCK (1907): The British Tunicata, Vol. II, pp. 155-159, Figs. 85 & 86.

SALFI (1931): Pubbl. Staz. Zool. Napoli, Vol. XI, p. 321, Fig. 17.

TOKIOKA (1950): Publ. Seto. Mar. Biol. Lab., I (3), pp. 124-125, Fig. 7.

Twenty-six zooids were found on *Clavelina* (*Synclavella*) *arafurensis*; most of them were more or less mutilated. They are all less than 1.7 mm in length. Many minute bladder cells spread over the test. Branchial aperture 6-lobed, atrial aperture 7-lobed. Around both apertures many corpuscular cells are aggregated densely. Branchial sac with 4 rows of stigmata, each row consisting of ca. 10 stigmata. Longitudinal vessels 8 on the left, 9 on the right side. Tentacles 19-20. Alimentary canal arranged as in specimens from the Palao Islands described by TOKIOKA (1950), although the anus seems to be situated

more anteriorly than in the Palao specimens. Gonad is not found in any zooid. Evidently the present specimens are younger individuals of the form of *P. listeri* collected in the Palao Islands.

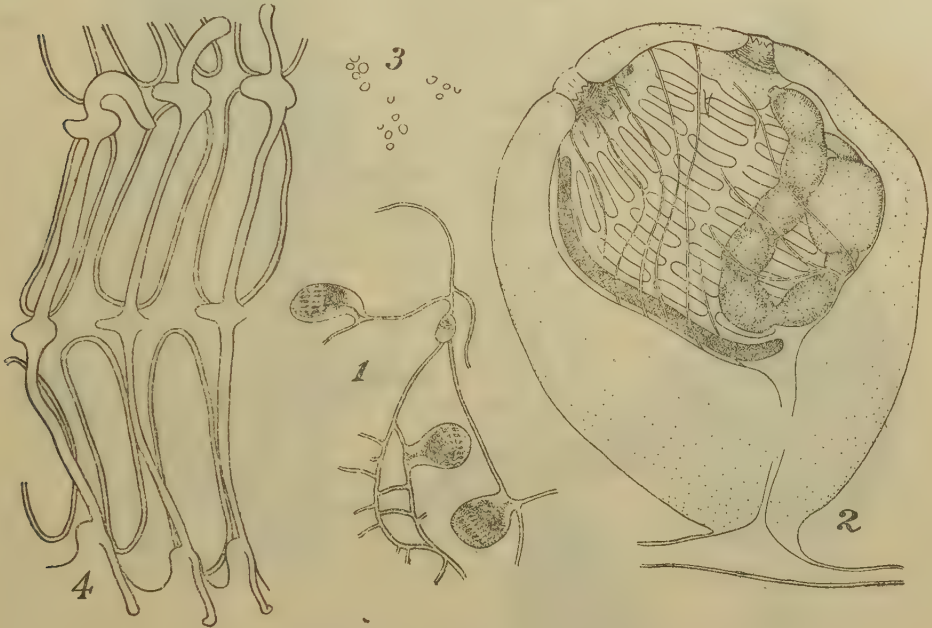


Fig. 8. *Perophora listeri* FORBES & HANLEY. 1—A part of the colony, 2—Zooid $\times 45$, 3—Groups of bladder cells in test $\times 200$, 4—A part of the branchial sac, from inside $\times 200$.

9. *Ascidia gemmata* SLUITER 1895

(Fig. 9)

Ascidia gemmata; SLUITER (1895): Semon Zool. Forschungsreisen V, pp. 177-178, Pl. IX, figs. 7-9.

HARTMEYER (1919): Kungl. Sv. Vetensk. Handl., Bd. 60, No. 4, pp. 95-97, Fig. 19, Pl. 2, fig. 49.

TOKICKA (1950): Publ. Seto Mar. Biol. Lab., I (3), pp. 131-133, Fig. 11, Pl. IX, fig. 2.

Five specimens in all. They are 97 mm, 83 mm, 74 mm, 35 mm long individuals and one which is much mutilated leaving only the anterior half of the body perfectly. The 83 mm long individual with enormously long atrial siphon. Minute papillae on the test are distinct in smaller individuals, but rather obsolete in larger ones. Branchial aperture 9, atrial aperture 6-lobed.

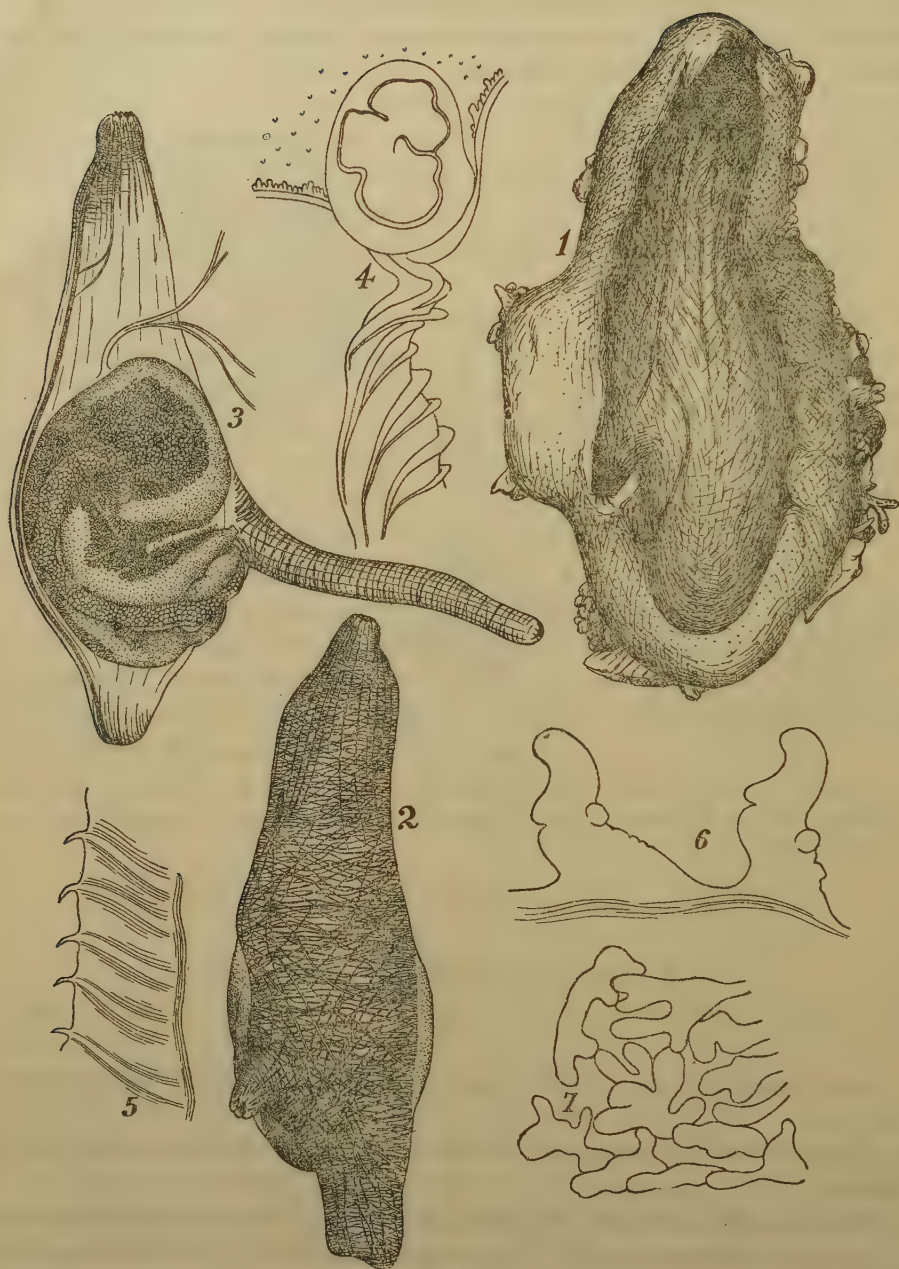


Fig. 9. *Ascidia gemmata* SLUITER. 1—Entire animal, 2—Right side of the mantle body, 3—Left side of the mantle body with enormously long atrial siphon, 4—Dorsal tubercle $\times 18$, 5—Dorsal lamina $\times 28$, 6—Supporting processes of the inner longitudinal vessels $\times 75$, 7—Testicular follicles, magnified.

Both siphons and the anterior part of the branchial sac are coloured in scarlet in life. Dorsal ganglion is situated slightly in front of the middle of the distance between the branchial and atrial apertures. Five to eight stigmata in a mesh of the branchial sac which is plicated slightly. Peripharyngeal band fringed anteriorly with minute papillae. Ciliated groove shows rather complex configuration. Tentacles ca. 65 excluding minute ones, large and small ones alternate with some regularity. They may reach up to 80 in number when we count minute ones together. Differences found between the specimens from Palao and those from the Arafura Sea are considered to be of the individual variation rather than the local variation or the variation according to stocks.

10. *Ascidia sydneyensis* STIMPSON 1855

(Fig. 10)

Ascidia sydneyensis; HARTMEYER (1919): Kungl. Sv. Vetensk. Handl., Bd. 60, No. 4, pp. 98-99, Pl. 2, fig. 50.

VAN NAME (1921): Bull. American Mus. Nat. Hist., Vol. XLIV, pp. 386-389, Figs. 62-65.

VAN NAME (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 189-190, Fig. 101.

TOKIOKA (1950): Publ. Seto Mar. Biol. Lab., I (3), p. 133, Fig. 12, Pl. IX, fig. 3.

Three specimens were collected by Mr. S. WADA. They are respectively 44 mm, 43 mm and 25 mm in length and armed sparsely with minute papillae on the test along the margin. Body attached to the substratum by its whole left side. Another two specimens respectively 48 mm and 23 mm long, were collected also by Mr. S. WADA. These individuals are provided with many distinct papillae on the whole surface of the test, some of which are represented in Fig. 10-3. Branchial aperture terminal and 8-9 lobed, atrial aperture at the middle of the body on the left margin and 6-lobed. Both siphons vary in length according to the condition of their environment. Mantle musculature restricted to the marginal portion, although in small younger individuals some loose muscular net-work can be seen on the central portion of the right side of the body. Branchial sac with slight plications and with ca. 8 stigmata in a mesh. Transverse vessels are arranged: large-small-medium-small-medium-small-medium small-large- -. Tentacles very long and ca. 90 in number. Peripharyngeal band fringed anteriorly with minute papillae. Dorsal tubercle situated far behind the tentacular ring. Dorsal ganglion situated at 1/3-1/4 of the distance between both siphons apart from the base of the branchial



Fig. 10. *Ascidia sydneyensis* STIMPSON. 1—Entire animal, 2—Two strongly papillated individuals, 3—Spherical attachment protuberances on the test $\times 12$, 4—Right side of the mantle body, 5—Left side of the mantle body, 6—Dorsal tubercle $\times 45$, 7—Dorsal lamina, 8—Supporting processes of the inner longitudinal vessels $\times 45$, 9—Testicular follicles, magnified.

siphon. Distance between the dorsal ganglion and the dorsal tubercle about one to two times the length of the ganglion. The anterior end of the intestinal loop reaches the middle of the distance between both siphons. Rectum is of uniform thickness throughout its whole course.

11. *Phallusia julinea* SLUITER 1919

(Figs. 11 and 12)

Phallusia julinea; SLUITER (1919): Bijl. Dierk., Afd. XXI, pp. 7-9, Figs. 13-16.

HARTMEYER (1919): Kungl. Sv. Vetensk. Handl., Bd. 60, No. 4, pp. 99-103, Fig. 20, Pl. 2, figs. 51-53.

HASTINGS (1931): Great Barrier Reef Exp., Vol. IV, No. 3, p. 81.

TOKIOKA (1950): Publ. Seto Mar. Biol. Lab., I (3), pp. 133, 135-136, Fig. 13, Pl. IX, fig. 4.

Three specimens up to 80 mm in length were collected by Mr. R. WADA and a large specimen, 94 mm long, by Mr. S. WADA. They attached to the substratum by their whole left side or by the posterior half or more of the left side. Test white, opaque and without any minute papillae on the surface, except in the smallest 45 mm long individual. Branchial aperture terminal, slightly bending to the left side and 8-10 lobed. Atrial aperture at the middle of the left margin of the body and 9-15 lobed. Each lobe pectinated and with an ocellus at each interval between the lobes. Mantle white or yellowish brown. In large specimens 11-12 stigmata in a mesh. Sixteen-nineteen thinner transverse vessels between each pair of thicker ones. Supporting processes of the inner longitudinal vessels are provided with distinct lateral prominences. Dorsal ganglion situated much nearer the atrial siphon than the branchial. Dorsal tubercle rather small. Ciliated groove shows a somewhat complex configuration in some individuals. Peripharyngeal band sparsely with minute papillae in some zooids. Secondary tubercles 20-39 in these specimens. Tentacles 37-66, excluding some minute ones. Anus with 14-17 lobules in some zooids.

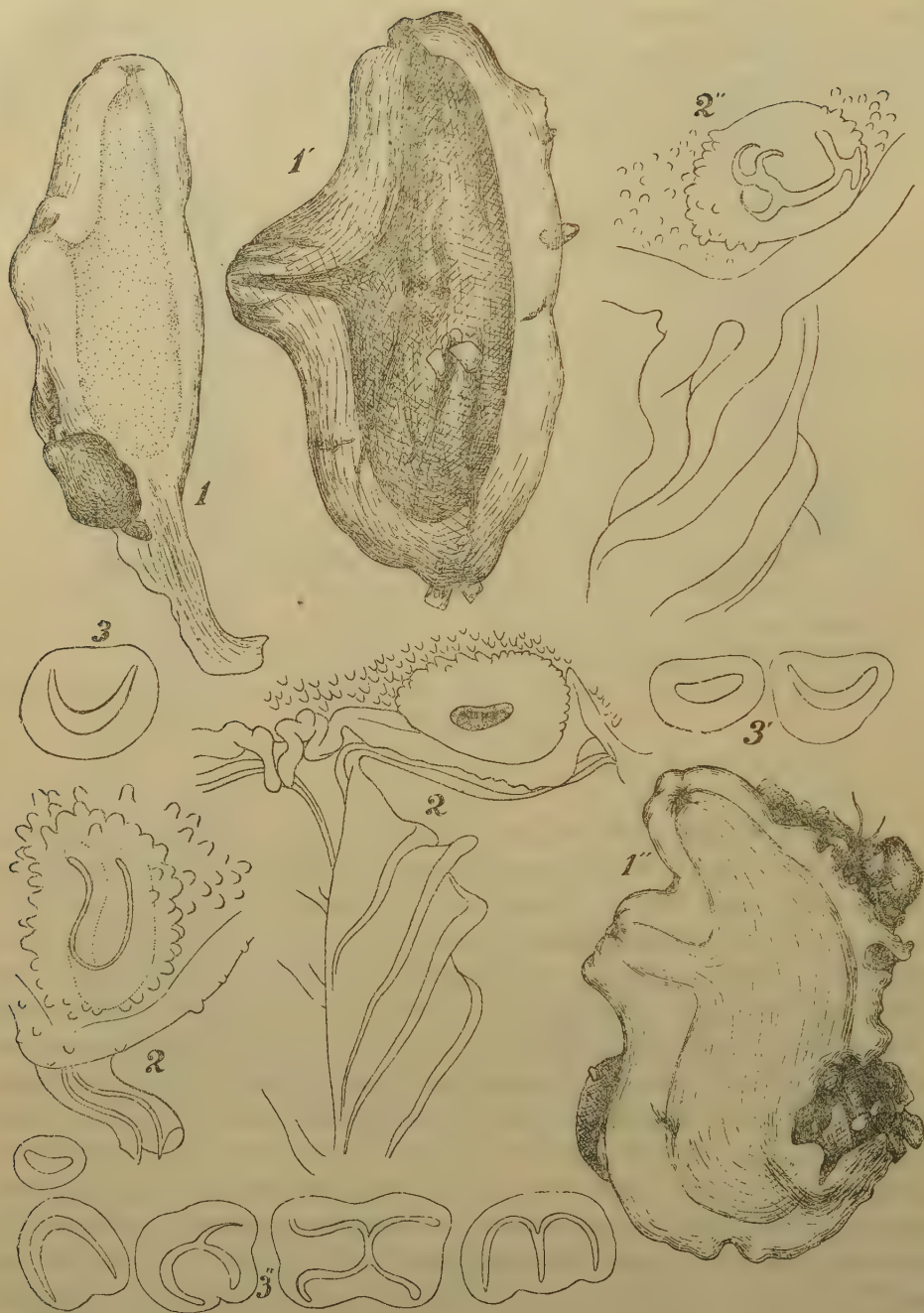


Fig. 11. *Phallusia julinea* SLUITER. 1-3: 45 mm long individual, 1'-3': 80 mm long individual, 1''-3'': 94 mm long individual. 1—Entire animal, 2—Dorsal tubercle $\times 45$, 3—Secondary tubercles.

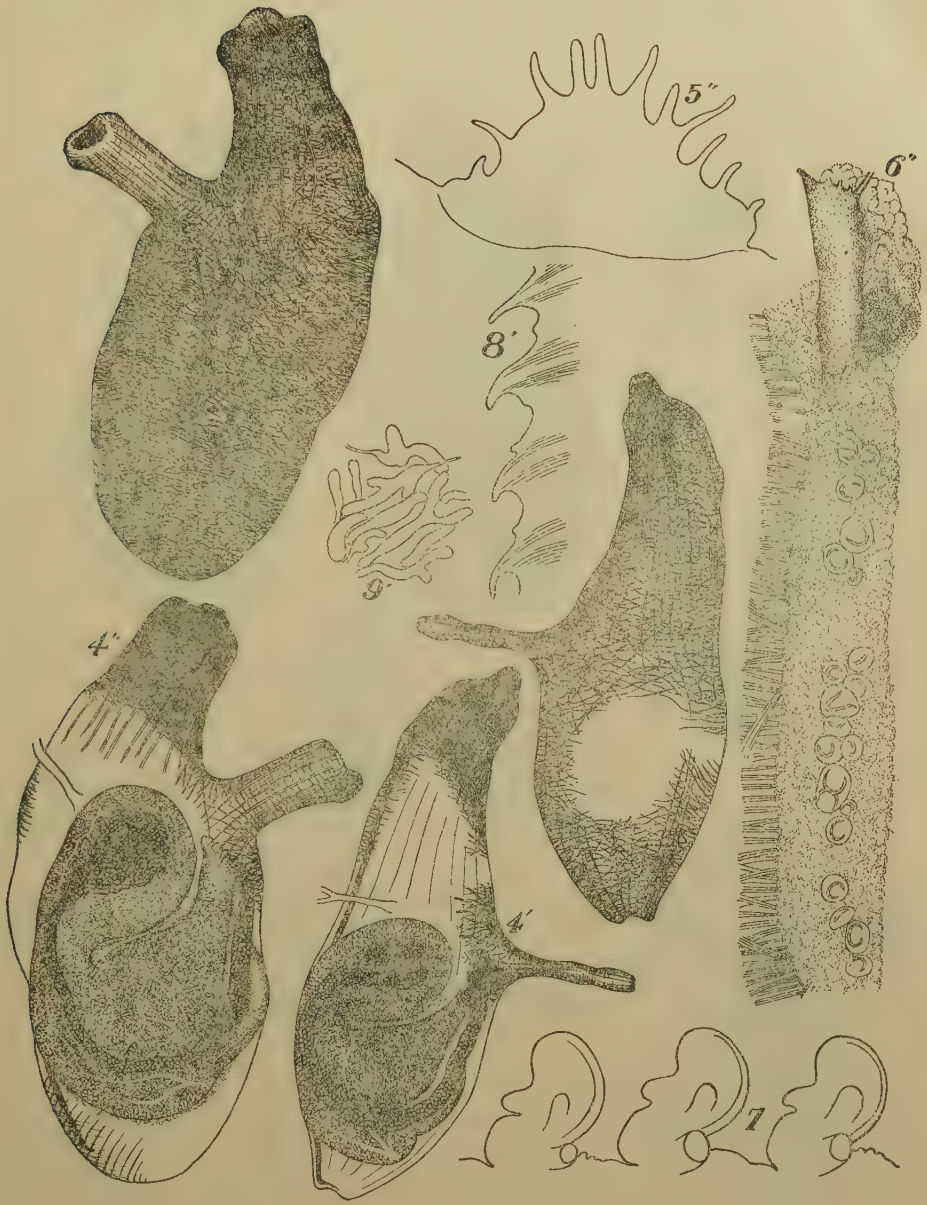


Fig. 12. *Phallusia julinea* SIUITER. 7: 45 mm long individual; 4', 8', 9: 80 mm long individual; 4"-6": 94 mm long individual. 4—Mantle body, 5—A pectinate lobe of atrial aperture $\times 45$, 6—Secondary tubercles $\times 12$, 7—Supporting processes of the inner longitudinal vessels $\times 75$, 8—Dorsal lamina $\times 45$, 9—Testicular follicles, magnified.

12. *Phallusia depressiuscula* (HELLER) 1878

(Fig. 13)

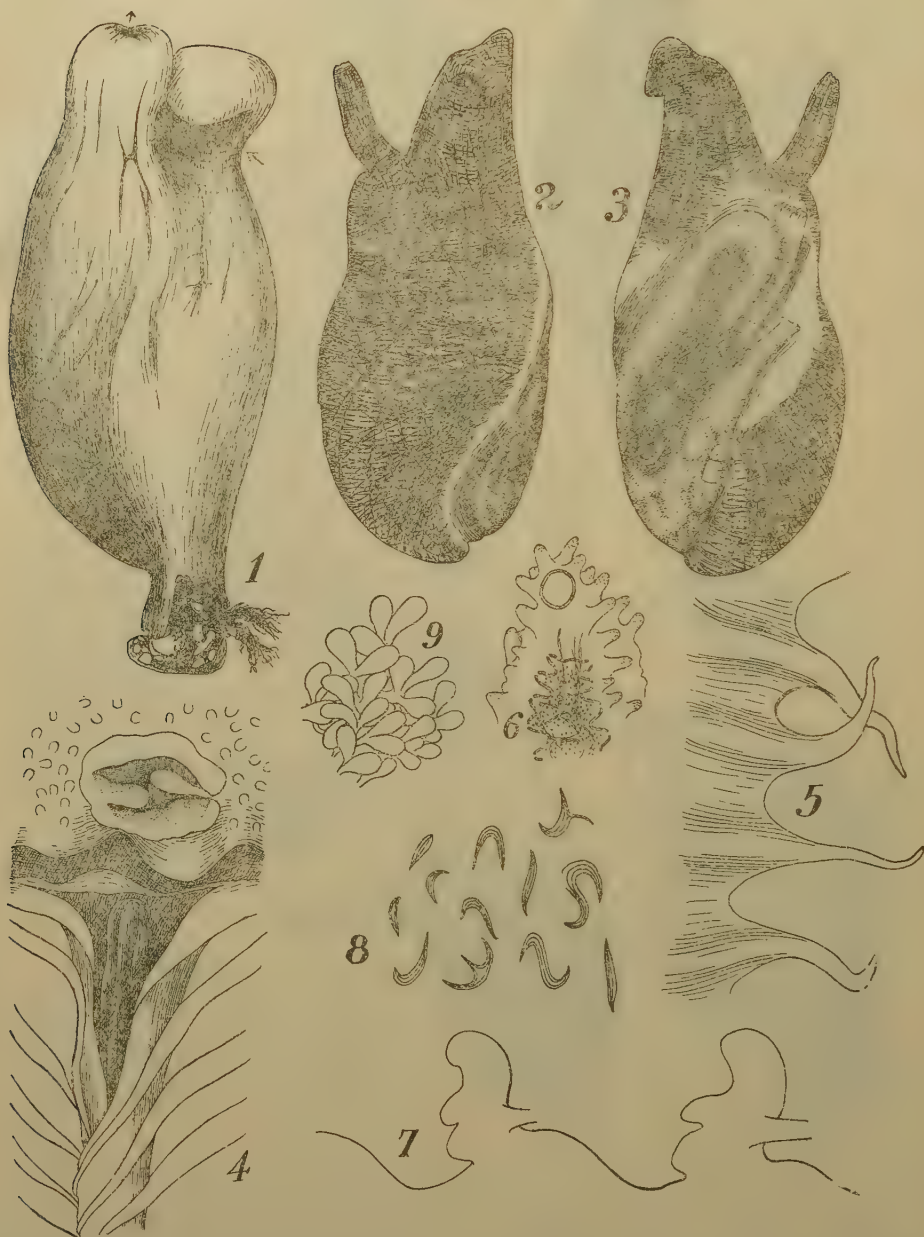


Fig. 13. *Phallusia depressiuscula* (HELLER). 1—Entire animal, 2—Right side of the mantle body, 3—Left side of the mantle body, 4—Dorsal tubercle $\times 45$, 5—Dorsal lamina $\times 45$, 6—Section of one of the outer prominences of the branchial sac $\times 56$, 7—Supporting processes of the inner longitudinal vessels $\times 56$, 8—Secondary ciliated grooves $\times 20$, 9—Testicular follicles, magnified.

Ascidia depressiuscula; HERDMAN (1906): Rep, Ceylon Pearl Oyster Fish., Pt. 5. Suppl. Rep. No. 39, p. 305, Pl. 2, figs. 10-22.

VAN NAME (1918): U.S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 116-119, Figs. 72-74.

HASTINGS (1931): Great Barrier Reef Exped., Vol., IV, No. 3, p. 80, Fig. 6.

A large, 90 mm long specimen was found by Mr. S. WADA. Body cylindrical and elongate ovate in outline, attached to the substratum by the posterior end of the body, which is narrowed to a short peduncle-like portion. Anterior part of the body cleft in two siphons of moderate length. Test whitish, semitransparent, cartilaginous and 3-4 mm in thickness in some thick places. Surface very smooth, although several slight grooves are observable. Mantle pinkish brown, muscular bands on the whole right side. Alimentary canal dark brown. Branchial aperture 12 (6×2)—lobed, atrial aperture 9-lobed.

Branchial sac: Branchial sac plicated and provided on the outer surface with many small papillated protuberances. Supporting processes of the inner longitudinal vessels without lateral prominence. Dorsal lamina is represented by two membranes in the range from the dorsal tubercle to the level of the dorsal ganglion which is situated near the base of the atrial siphon; behind the ganglion these two membranes are united to a membrane with terminally projecting out ribs. Dorsal tubercle very small and with I-shaped ciliated groove. Secondary ciliated grooves very abundant, for instance 67 on the left side, and open directly on the even inner surface of the mantle, without forming any tubercle. Most of them are simple in outline and may reach 500 μ in length in larger ones. Prebranchial area papillated. Tentacles a. 80. Most of them are larger, small ones very few in number.

Alimentary system: Anterior margin of intestinal loop does not reach beyond the base of the atrial siphon. The loop long and narrow. Axis of the second intestinal loop passes behind the stomach. Rectum without any swelling. Anus fringed with 14-lobes, each of which consisting of 2-3 lobules.

Gonad: As in common species of *Ascidia*.

13. *Rhodosoma turcicum* (SAVIGNY) 1816

(Fig. 14)

Rhodosoma papillosum; TRAUSTEDT (1885): Vid. Meddel. fra naturh. Foren., ann. 1884, p. 9.

SLUITER (1904): Siboga Exped., Monogr. 56 a, pp. 26-27, Pl. I, fig. 2, Pl. IV, figs. 4-6.

HARTMEYER (1906): Zool. Anz., Vol. 31, p. 25.

HERDMAN (1906): Ceylon Pearl Oyster Fish., Suppl. Rep., No. 39, p. 302.

VAN NAME (1918): U.S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 113-116, Figs. 68-71.

HARTMEYER (1919): Kungl. Sv. Vetensk. Handl., Vol. 60, No. 4, p. 95.

Rhodosoma pallucidum; VAN NAME (1921): Bull. American Mus. Nat. Hist., Vol. 4, 392-395, Figs. 69-70.

VAN NAME (1924): Bijdr. Dierk. Afl. XXIII, p. 29.

Rhodosoma turcicum; VAN NAME (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 203-205, Figs. 116-117.

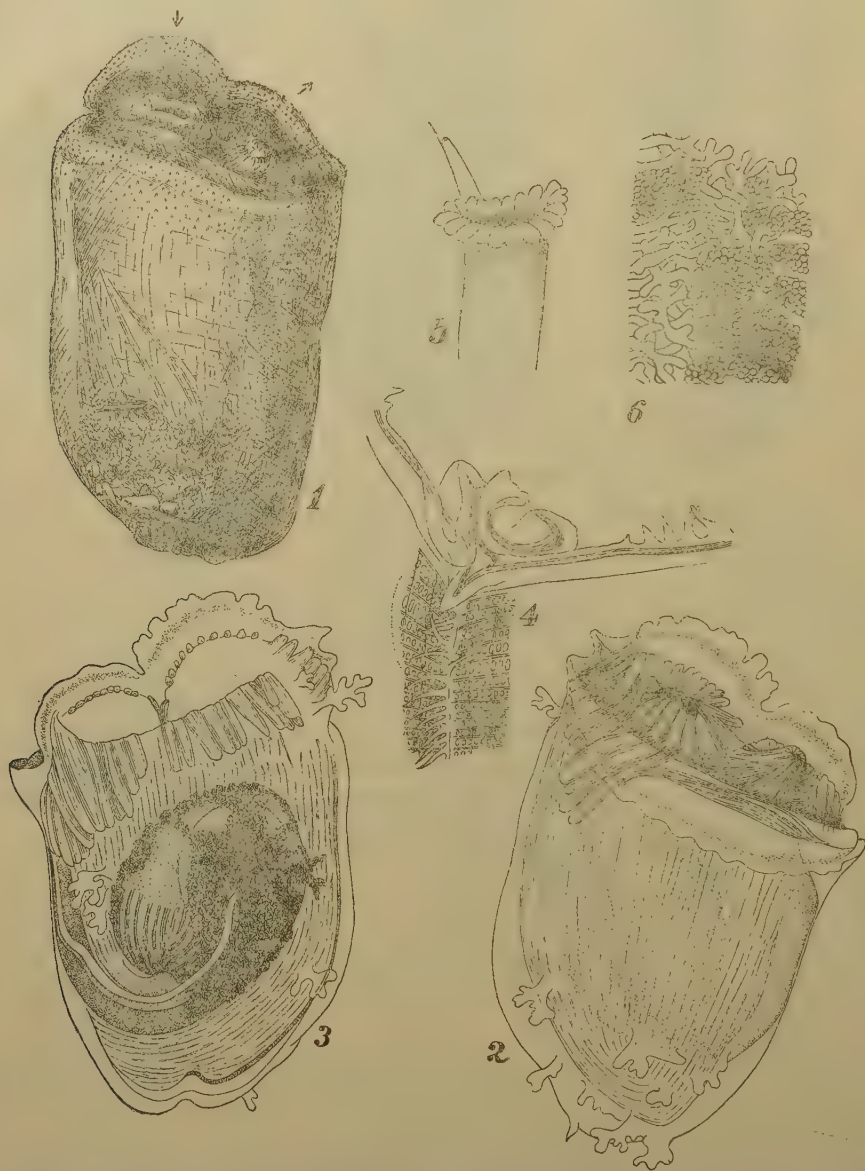


Fig. 14. *Rhodosoma turcicum* (SAVIGNY). 1—Entire animal, 2—Left side of the mantle body, 3—Right side of the mantle body, 4—Dorsal tubercle and dorsal languets $\times 45$, 5—Anus, 6—A part of the gonad.

One specimen of 50 mm long×33 mm wide×15 mm thick, attached to the substratum by its whole right side and with many sponges and hydrozoans on the surface. Branchial aperture 7-lobed, while atrial lobes are quite obscure. About 4 stigmata in a mesh. Anus fringed with ca. 25 lobules.

14. *Stolonica (Amphicarpa) sigma* n. sp.

(Fig. 15)

One colony consisting of ca. 50 zooids was offered to me by Mr. S. WADA. Zooids are connected one another by creeping stolon issued from the postero-ventral corner of the animals. Body length 9-12 mm. Branchial aperture terminal, atrial aperture slightly aparting from it. Both apertures 4-lobed; siphons very short. Test of moderate thickness, yellowish white and with many sand grains and other small foreign matters on the surface, especially remarkably on the left side. Mantle rather thick, reddish-brown in colour and adherent to the test. Four dark brown spots around the aperture of each siphon. Several endocarps on the inner surface of the mantle on each side.

Branchial sac: Two folds on each side. Inner longitudinal vessels arranged as follows:

A large zooid:

Left	D.	1	(9)	3	(7)	4	V.
Right	D.	4	(8)	3	(6)	6	V.

A medium-sized zooid:

Left	D.	1	(10)	4	(7)	4	V.
Right	D.	4	(9)	3	(6)	6	V.

Thick transverse vessels and thin parastigmatic vessels alternate regularly. About 5 stigmata in a mesh. Tentacles 42-50 excluding minute ones. Ciliated groove a longitudinal slit; small pigment flecks dispersed on the tubercle. Dorsal lamina a plain membrane.

Alimentary system: Alimentary canal curves strongly so as to figure S on the inner surface of the mantle on the ventro-sinistral side. Stomach small and round, with ca. 8 plications on each side. Pyloric coecum absent, while a short vessel connecting the pyloric portion of the stomach to the intestine. Anus plainly margined. A large endocarp in the first intestinal loop. The axis of the second intestinal loop passes the middle of the stomach.

Goadn: Many ovaries, up to 20, arranged roughly in a row along the ventral side of the right side and much less ones, about a half of those on the

right side, along the ventral side of the left side, also arranged in a row. Many oval testes arranged roughly in a group near the dorsal margin on the right side being apart from ovaries, while they are distributed dorso posteriorly to ovaries on the left side.

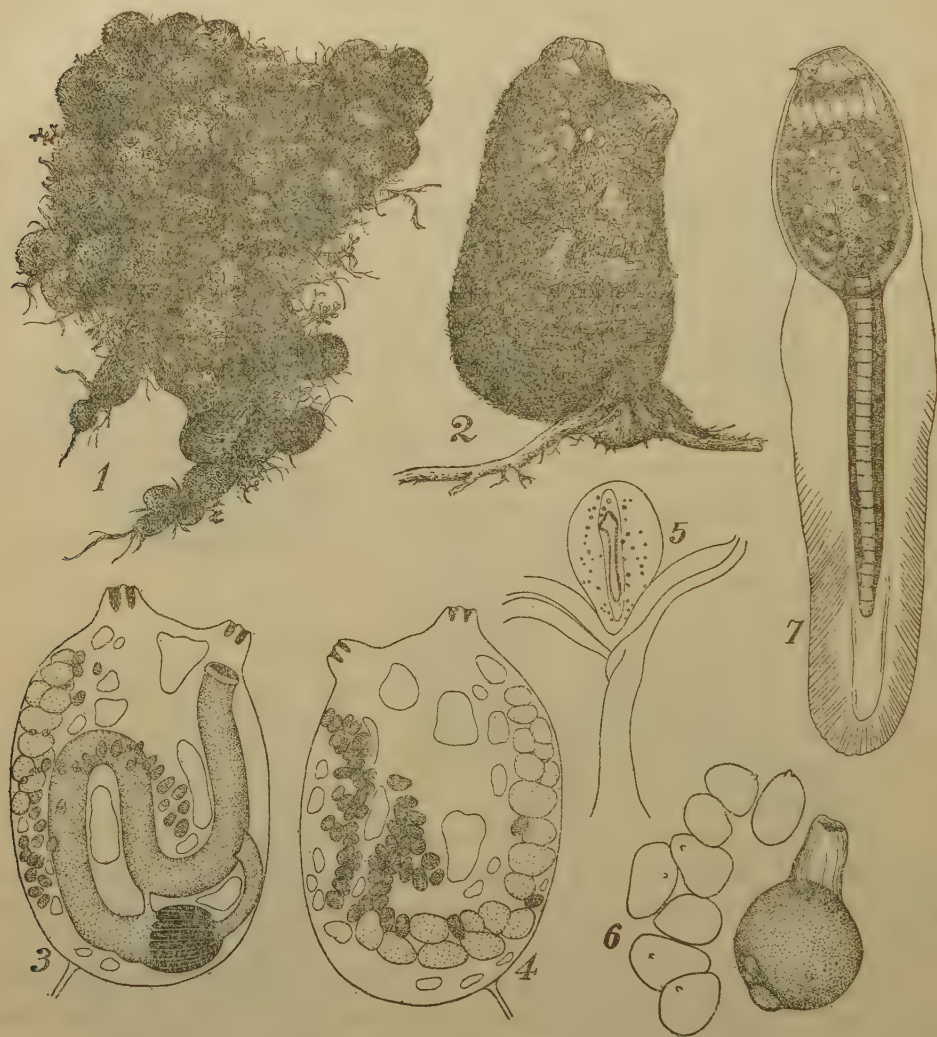


Fig. 15. *Stolonica (Amphicarpa) sigma* n. sp. 1—Entire colony, 2—A zooid, 3—Left half from inside; 4—Right half from inside, 5—Dorsal tubercle×45, 6—An ovary and several testes×28, 7—Larva×27.

Larva: Peculiar larvae, up to 9 in number, found in the peribranchial cavity being situated with their anterior ends towards the endostyle. Much

more larvae in the right cavity than in the left. The anterior end of the trunk narrowed slightly and with three attachment processes situated in a triangle. Sixteen ampullae situated behind the attachment organs. Each ampulla pigmented darkly at the anterior portion and provided with a vessel running posteriorly, which issues several short branches ending each in a small bulb pigmented distally as in the ampulla, on the way to the posterior end of the trunk.

Remarks: The present new species differs from its allies, *S. styeliformis* VAN NAME from the Philippine waters, *S. duploplicata* SLUITER from Aru Islands and *Dislonus diptychos* HARTMEYER from Cape Jaubert, in having the alimentary canal curved much more strongly than in these species.

15. *Polyandrocarpa* (*Eusynstyela*) *latericius* (SLUITER) 1904

(Fig. 16)

Gynandrocarpa latericius; SLUITER (1904): Siboga-Exped., Monogr. 56 a, pp. 94-95, Pl. XV, figs. 8-11.

Eusynstyela latericius; VAN NAME (1918): U.S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 105-107, Figs. 58-60.

A colony, ca. 30 mm × 40 mm in extent and ca. 2 mm in thickness, was found by Mr. R. WADA. Zooid 6-7 mm in length. Branchial and atrial apertures respectively at each terminal. Test rather thick, yellowish white with dark reddish tint around the apertures. The neighbourhood of each aperture swells up to a low dome and with 4 thick and 2 or 4 thin colour bands converging to the aperture. Inner surface of test white, excepting the neighbourhood of the apertures where it is coloured red. Mantle yellow and semitransparent. Atrial tentacles on the atrial velum, especially densely along its margin. A pair of groups of corpuscular cells near the anterior end of the endosyle. Endocarps present; those on the lateral side of the body are all transversely elongate.

Branchial sac: With two distinct and two indistinct folds on each side. They are rather groups of inner longitudinal vessels than the fold. Vessels arranged as follows:

1st zooid:

Left	D.	0	(9)	0	(5)	0	(17)	0	(10)	0	V.
Right	D.	0	(14)	0	(5)	0	(13)	0	(4)	0	V.

2nd zooid:

Left	D.	0	(11)	0	(8)	0	(14)	0	(8)	0	V.
Right	D.	0	(14)	0	(6)	0	(14)	0	(7)	0	V.

3rd zooid:

Left	D.	0	(12)	0	(7)	0	(15)	0	(9)	0	V.
Right	D.	0	(13)	0	(7)	0	(14)	0	(3)	0	V.

Folds I and III are distinct. As the formation of the fold is incomplete, the distinction between the intermediate longitudinal vessels and those on the folds is rather obscure. Transverse vessels arranged—thick—thin—thick—thin—. Parastigmatic vessels found only rarely. Stigmata-rows ca. 20. Stigmata in a mesh less than 5, usually ca. 4. Tentacles reddish brown in colour and consisting of 6-8 large and 3-6 small ones. Ciliated groove a longitudinal slit. Dorsal lamina with thickened brownish margin.

Alimentary system: Alimentary canal situated in the posterior half of

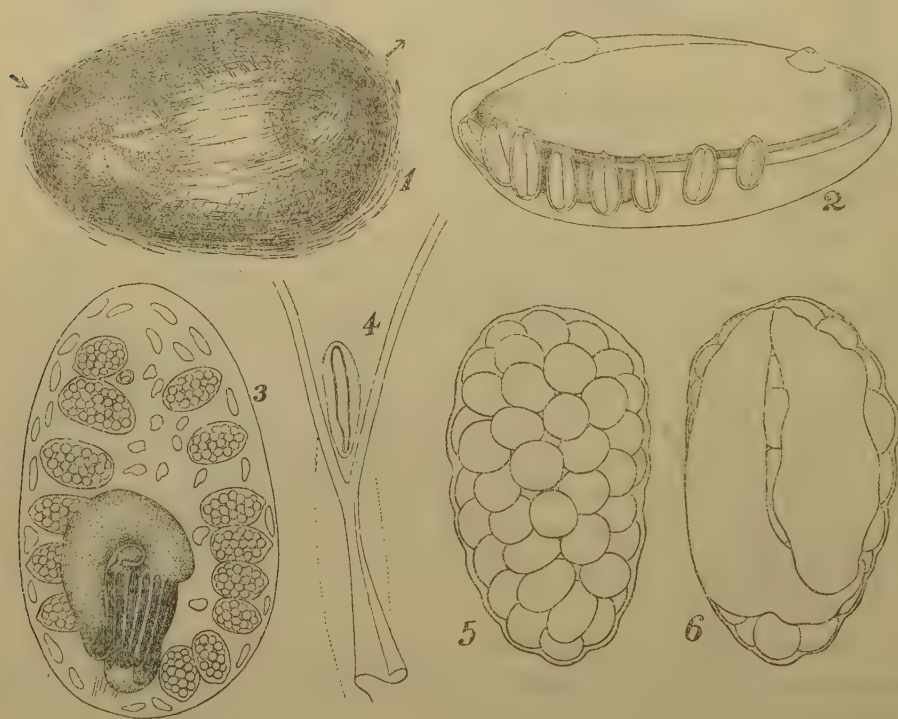


Fig. 16. *Polyandrocarpa* (*Eusynstyela*) *laevis* (SLUITER). 1—A zooid from dorsal, 2—Mantle body from right side, 3—Ventral half from inside, 4—Ciliated groove $\times 45$, 5—Gonad free surface $\times$ ca. 30; 6—Gonad, attachment surface $\times$ ca. 30.

the ventral side of the body. Loop simple. Stomach a half of the length of the loop and with a distinct pyloric coecum and about 7 plications on each side. Anus with brownish, thickened and undulating margin, but without lobation.

Gonad: Seven to ten hermaphroditic gonads on each side. Each gonad elliptical in shape and with two testicular follicles on the side of attachment.

16. *Polycarpa papillata* (SLUITER) 1886

(Fig. 17)

Styela papillata; SLUITER (1886): *Natuurk. Tijdschr. Ned.-Ind.*, XLV, pp. 192-195, Pl. 1, fig. 8, Pl. 5, figs. 1-4.

SLUITER (1891): *Natuurk. Tijdschr. Ned.-Ind.*, I, p. 333.

Three specimens, respectively 60 mm, 35 mm and 23 mm in length, were collected by Mr. R. WADA. The smallest one is oval in shape, while other two individuals are rather elongate and each with a posterior peduncle-like extension of the body. Branchial aperture terminal; atrial aperture slightly in front of the middle of the body or body proper, the posterior base of the thick dome-like atrial siphon at just the middle of the body. Both apertures 4-lobed. Body attached to the substratum by its right and posterior side. Test not thick, but very tough, grayish yellow to yellowish brown in colour and with many irregular grooves on the surface in the largest specimen. In the medium-sized individual, test rather smooth except the neighbourhood of the apertures, where it is furnished with grooves. The smallest one adheres a small amount of foreign matters on its surface which is grooved irregularly, especially around the apertures. Mantle yellow to orange; both siphons dark red, brown or grayish yellow. Inner surface of test slightly pale in colour. Many minute atrial tentacles on the inner surface of the atrial siphon. Many endocarps on the inner surface of the mantle.

Branchial sac: Inner longitudinal vessels as follows:

60 mm long individual:

Left	D.	5	(14)	6	(17)	6	(16)	6	(13)	5	V.
Right	D.	5	(15)	6	(16)	5	(14)	5	(12)	6	V.

23 mm long individual:

Left	D.	3	(15)	3	(14)	3	(13)	3	(12)	3	V.
Right	D.	3	(14)	3	(14)	3	(14)	3	(12)	3	V.

About 3 thin transverse vessels between a pair of thicker ones. Parastigmatic vessels present. Five to eight stigmata in a mesh. Papillae found by

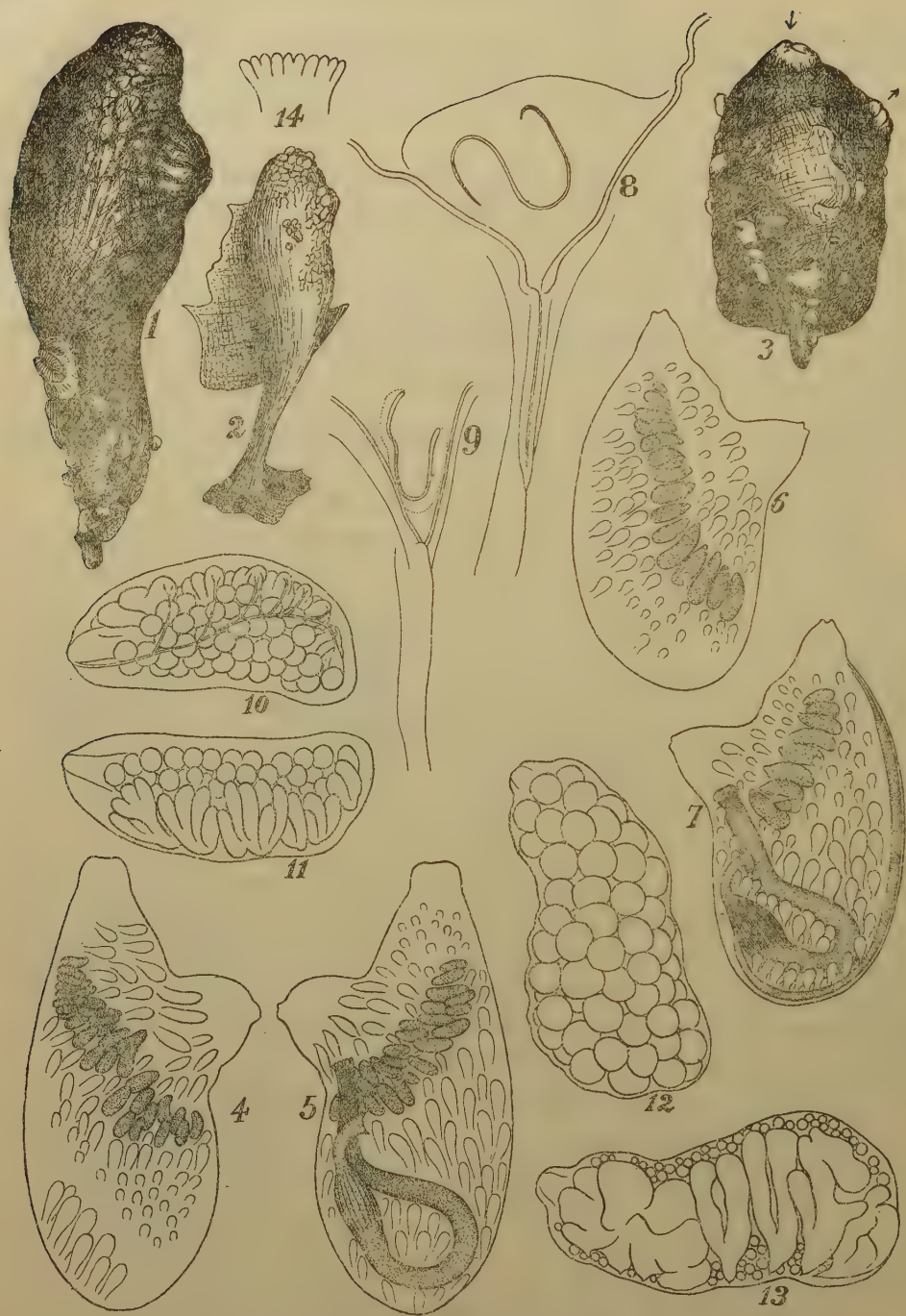


Fig. 17. *Polycarpa papillata* (SLUTIER). 1—60 mm long individual, left side; 2—35 mm long individual, left side; 3—23 mm long individual, left side. 4, 5, 8, 10, 11, 14—60 mm long individual, 6, 7, 9, 12. 13—23 mm long individual. 4—Right half from inside, 5—Left half from inside, 6—Right half from inside, 7—Left half from inside. 8—Ciliated groove $\times 28$, 9—Ciliated groove $\times 45$, 10—Gonad, free surface $\times 14$; 11—Gonad, attachment surface $\times 14$; 12—Gonad, free surface $\times 28$; 13—Gonad, attachment surface $\times 28$; 14—Anus.

SLUTER on the inner surface of the branchial sac quite obscure on my present material. Tentacles 14-21, large and small ones alternate somewhat regularly. Ciliated groove figures U or S-shaped courses.

Alimentary system: Loop of the alimentary canal simple and situated in the posterior third of the body, Intestinal loop rather wide and contains many endocarps therein. Stomach not so thicker than the following intestine; rather faint plications on the surface. Pyloric coecum absent. Anus with 13-16 lobules.

Gonad: In 23 mm long individual, 10-15 gonads are arranged in a row along the dorsal side of the left half body and along the median axis of the right half-body, while in 60 mm long individual much more gonads are arranged roughly in two longitudinal rows on each side in the anterior half of the body. Each gonad elliptical and provided with several testicular follicles, each of which ramified into a few lobules.

17. *Polycarpa longiformis* n. sp.

(Fig. 18)

Two specimens, respectively 70 mm and 55 mm in length, were collected by Mr. S. WADA. Body elongate oval, attached by the posterior end and with siphons at the anterior end of the body, of which the atrial longer than the branchial. Test grayish purple, opaque, cartilaginous and rather thick measuring ca. 2 mm at many places. Surface smooth, with little grooves. Mantle with well developed musculature, semitransparent and purplish brown in colour. Branchial aperture 6(?)-lobed, atrial aperture 4-lobed. Many endocarps on the inner surface, especially those near the posterior end of the body are prominent.

Branchial sac: Longitudinal vessels arranged as follows in 70 mm long individual.

Left	D.	5	(16)	6	(17)	6	(16)	6	(13)	5	V.
Right	D.	4	(18)	6	(16)	5	(15)	6	(12)	6	V.

Three to five thinner transverse vessels between each pair of thicker ones. Parastigmatic vessels present. Five to seven elongate stigmata in a mesh. Tentacles 44 in 70 mm long individual and consisting of large, medium, small and minute ones. Ciliated groove S-shaped. Dorsal lamina a plain membrane.

Alimentary system: Loop very simple, with roundish stomach near the

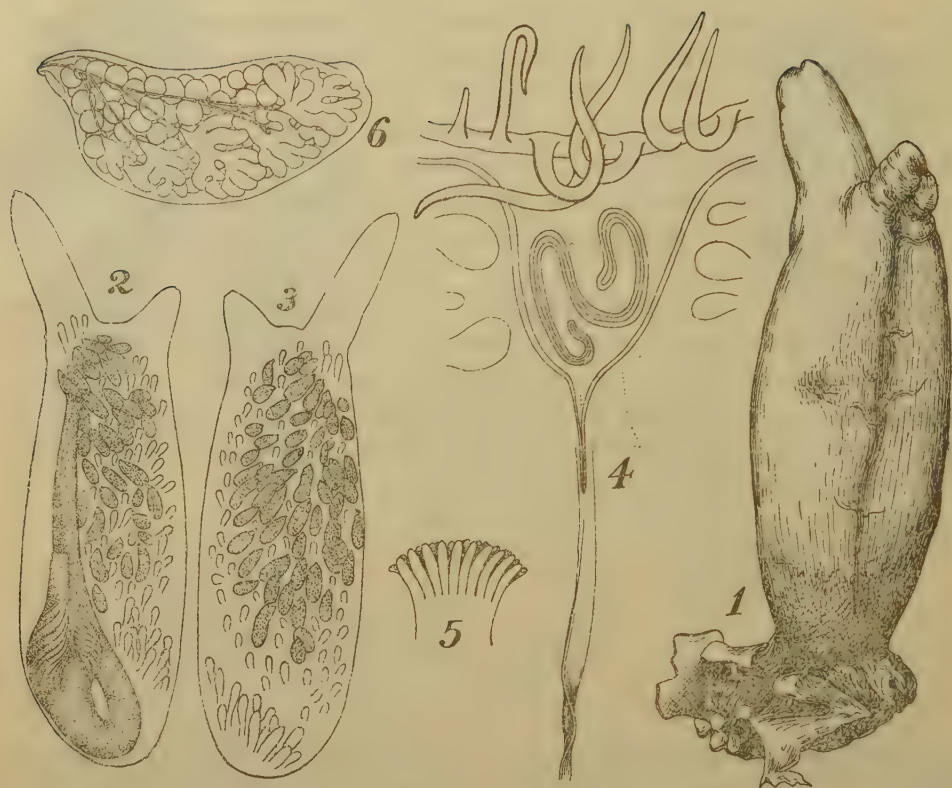


Fig. 18. *Polycarpa longiformis* n. sp. 1—70 mm long individual, 2—Left half from inside, 3—Right half from inside, 4—Tentacles and ciliated groove $\times 14$, 5—Anus, 6—Gonad $\times 14$.

posterior end of the body and long rectum. Stomach plicated, but without pyloric coecum. Anus finely lobated.

Gonad: Distributed evenly on the inner surface of each side. Each gonad oval in shape and provided with several testicular follicles which are ramified each in a few lobules.

18. *Polycarpa longicarpa* n. sp.

(Figs. 19 and 20)

One specimen, 14 mm long, was found on the colony of *Stolonica*. Besides

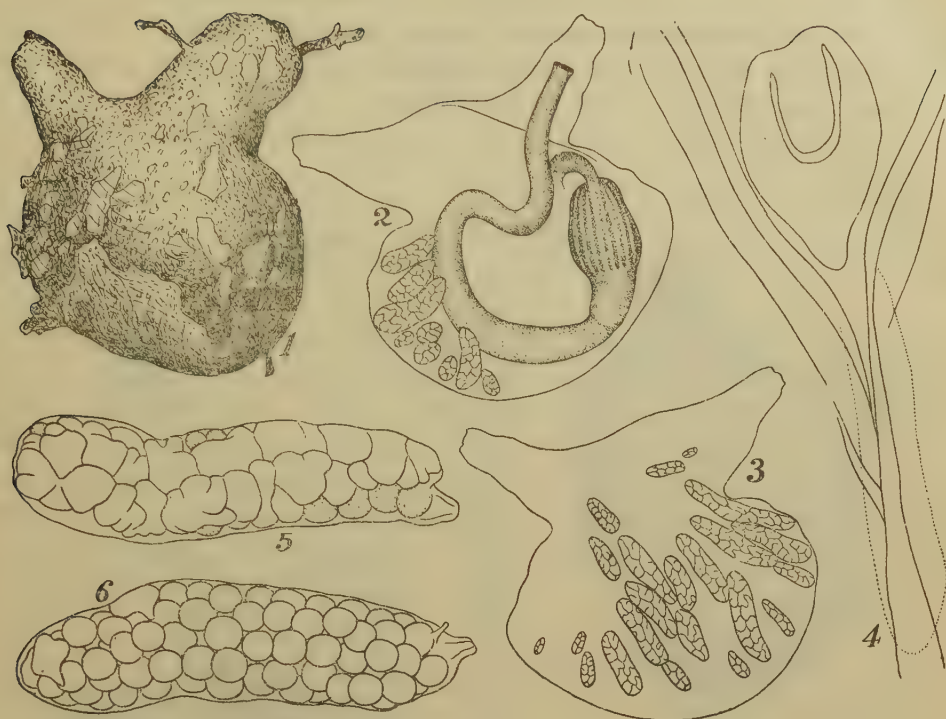


Fig. 19. *Polycarpa longicarpa* n. sp. 1—Entire animal from right side, 2—Left half of mantle body from outside, 3—Right half of mantle body from outside, 4—Dorsal tubercle $\times 45$, 5—Gonad, attachment surface $\times 28$; 6—Gonad, free surface $\times 28$.

a young 11 mm long specimen on a specimen of the preceding species. Body roughly oval in outline, with prominent siphons at the anterior end and attached by its whole left side. Test yellowish white in colour and thin, but very tough and adheres many sand grains and mud on the surface. Both apertures 4-lobed. Mantle thin, translucent and pinkish or light brownish in colour. Siphons of considerable length. Atrial velum well developed.

Branchial sac: Inner longitudinal vessels arranged as follows:

Young individual:

Left	D.	4	(7)	5	(7)	5	(6)	5	(6)	5	V.
Right	D.	4	(5)	4	(7)	4	(6)	4	(7)	5	V.

Mature individual:

Left	D.	4	(10)	5	(13)	5	(11)	4	(7)	6	V.
Right	D.	4	(10)	5	(15)	5	(12)	6	(10)	7	V.

Three to seven thinner transverse vessels between each pair of thicker ones. Parastigmatic vessels present. About 3 stigmata in a mesh. Tentacles 28 in young and 40 in large specimen including minute ones. Ciliated groove U-shaped. Dorsal lamina a low plain membrane.



Fig. 20. *Polycarpa longicarpa* n. sp. Young individual. 1—Entire animal from right side, 2—Left half of mantle body from outside, 3—Dorsal tubercle $\times 45$, 4—Anus.

Alimentary system: The second intestinal loop is formed evidently, although it is very shallow. The first loop very wide. Stomach globular and with 16 plications, though the plication is somewhat obscure in large specimen. Anus fringed with 13-20 lobules.

Gonad: Young specimen immature. About 20 elongate pinkish gonads on the right and 9 ones along the ventral margin of the left side. Large gonad with about a dozen testicular follicles on the side of attachment.

Remarks: The elongate shape of gonad is the most remarkable characteristic of the present new species.

19. *Polycarpa quadrata* HERDMAN 1881

(Fig. 21)

Polycarpa quadrata; HERDMAN (1882): Rep. Voy. Challenger, Vol. 6, Tunicata, pp. 173-174, Pl. 22, figs. 8-10.

TRAUSTEDT (1885): Vid. Meddel. fra naturh. Foren., ann., 1884, p. 48.

Styela quadrata; SLUITER (1904): Siboga-Exped., Monogr. 56 a, p. 126.

Pandocia quadrata; VAN NAME (1918): U. S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 99-101, Figs. 50-52, Pl. 31, fig. 34.

A very young individual, only 5 mm long excluding the posterior extension of the test, was found attached on the colony of *Polycitor renzi-wadai*. Body oval in outline, strongly compressed laterally and attached by the left side. Test thin, translucent, with some sand grains on the surface and sprinkled with pale purplish brown colour spots near the anterior end of the body. Both apertures terminal and 4-lobed. Siphons quite obscure. Mantle extremely thin, reddish orange to reddish brown in colour. Several endocarps on the inner surface

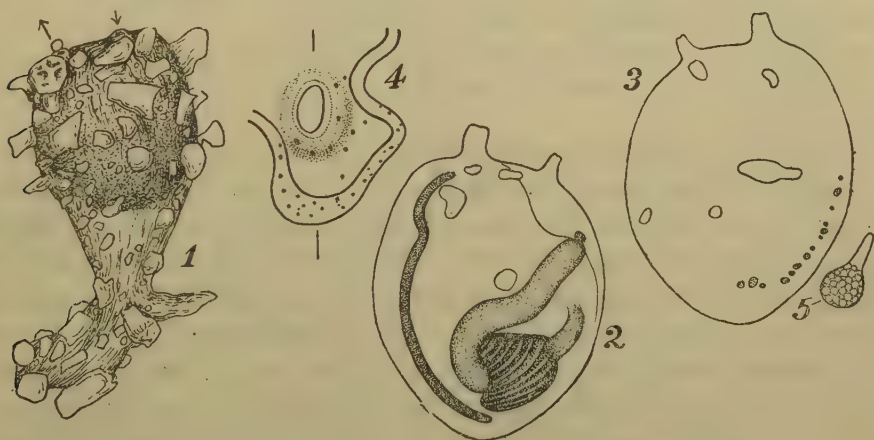


Fig. 21. *Polycarpa quadrata* HERDMAN. Young individual. 1—Entire animal from right side, 2—Left half of mantle body from outside, 3—Right half of mantle body from outside, 4—Ciliated groove $\times 110$, 5—An immature gonad.

Branchial sac: Folds are not yet fully formed. Inner longitudinal vessels arranged as follows:

Left	D.	4	(10)	0	(3-4)	0	(5-6)	3	V.
Right	D.	3	(7)	0	(5)	0	(6)	0	(6) 2 V.

Transverse vessels and parastigmatic vessels alternate regularly. Stigmata rows only 12. Two elongate stigmata in a mesh. Tentacles 12 in total, ciliat-

ed groove an oval opening, dorsal lamina a plain membrane. Many small pigment spots sprinkled around the dorsal tubercle.

Alimentary system: Loop simple. Rectum nearly straight, with a slight bending near the middle of its course. Stomach globular, with ca. 12 plications on each side. Margin of anus thickened, lobation quite obscure.

Gonad: Fourteen immature gonads are arranged in a row along the postero-ventral margin on the right side. None on the left side.

Remarks: I refer to the present specimen with some doubts. It is, however, very probable that the present specimen represents a young individual of *P. quadrata*, since the appearance of the alimentary canal, the simple figure of ciliated groove and the arrangement of gonads in a row along the postero-ventral side in the former quite coincide with those in the latter.

20. *Polycarpa aurita* (SLUITER) 1890

(Fig. 22)

Styela aurita; SLUITER (1890): Natuurk. Tijdschr. Ned.-Ind., L, pp. 338-340, Pl. 2, fig. 12.

SLUITER (1904): Siboga-Exped., Monogr. 56 a, p. 59.

Polycarpa aurita; SLUITER (1919): Bijd. Dierk., Afl. XXI, p. 3.

HARTMEYER (1919): Kungl. Sv. Vetensk. Handl., Bd. 60, No. 4, pp. 81-86, Pl. 2, figs. 43-47.

HASTINGS (1931): Great Barrier Reef Exped., Vol. IV, No. 3, pp. 75-76, Fig. 2.

Two specimens were collected by Mr. R. WADA. The larger one is 61 mm long $\times$ 40 mm wide and with 37 mm height, while the smaller one is 30 mm in length. Body oval, attached to the substratum by the postero-ventral side. Branchial aperture terminal, atrial aperture slightly in front of the middle of the body and slightly displaced to the right side from the dorso-median line. Both apertures 4-lobed. Siphons indistinct. Test whitish yellow to grayish yellow, ca. 2 mm in thickness, leathery and very tough and strong, with many grooves and folds on the surface, especially in the antero-dextral part of the body. Sponges, Bryozoans etc. are adhered on the surface. Inner surface of the test white. Mantle very thick, reaching 3 mm in some places, yellow-yellowish gray in colour and somewhat darkly coloured around the apertures. Many blood vessels are issued outwards from the outer surface of the mantle. Many large endocarps present. Those along the ventral margin and along the alimentary canal are very large, reaching ca. 9 mm in length. Extremely delicate atrial tentacles on the margin of the atrial velum.

Branchial sac: Inner longitudinal vessels arranged as follows:

61 mm long individual:

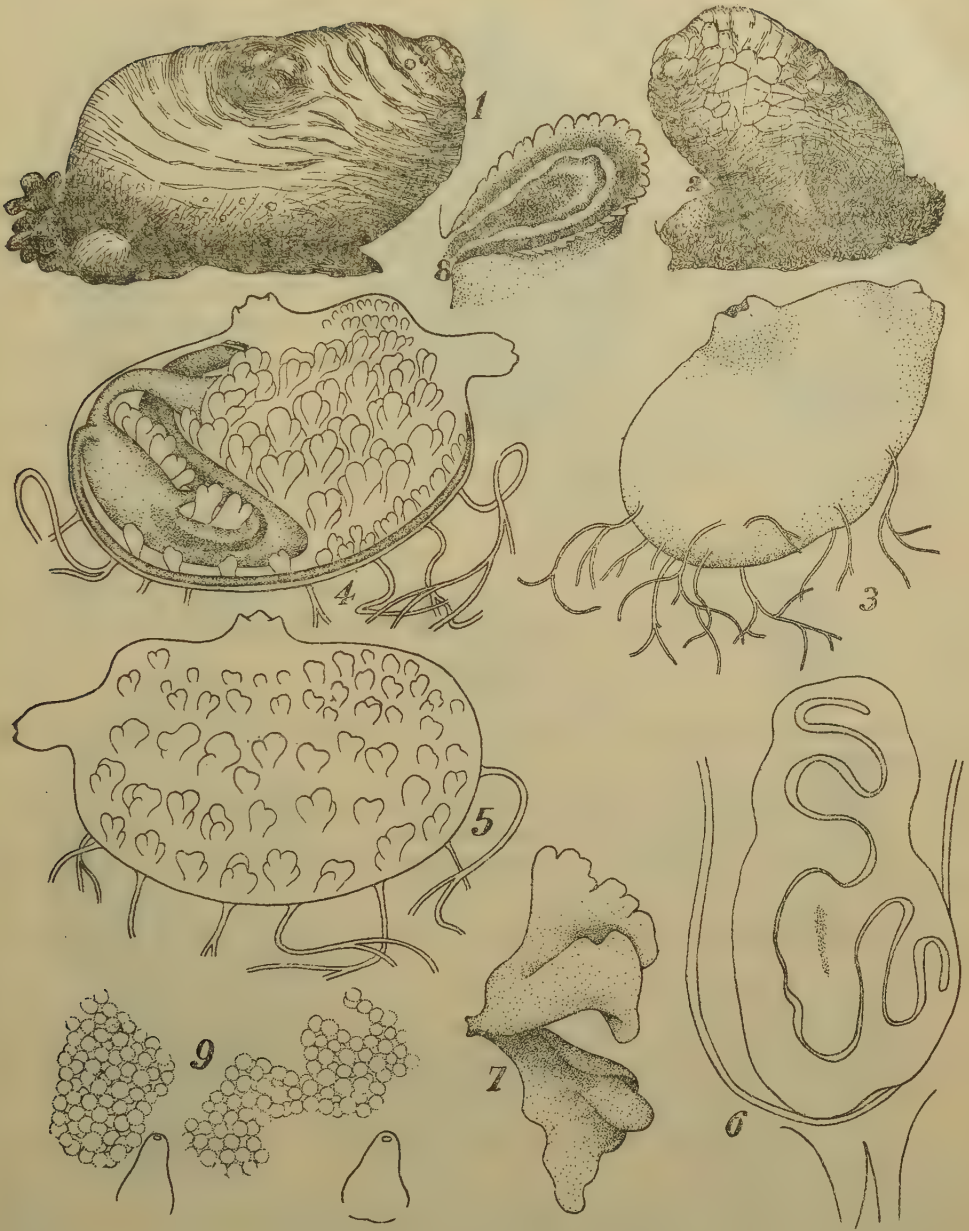


Fig. 22. *Polycarpa aurita* (SLUITER). 1—51 mm long individual, 2—30 mm long individual, 3—Mantle body from right side, 4—Left half from inside, 5—Right half from inside, 6—Dorsal tubercle $\times 12$, 7—A large endocarp, 8—Anus, 9—A part of mantle, showing two genital apertures $\times 45$.

Left	D.	5	(30)	6	(36)	8	(40)	8	(45)	8	V.
Right	D.	6	(27)	8	(50)	10	(60-70)	10	(50)	8	V.
30 mm long individual:											
Left	D.	5	(40)	6	(31)	7	(27)	5	(22)	4	V.
Right	D.	5	(39)	5	(32)	7	(28)	7	(25)	3	V.

Three to seven thinner transverse vessels between each pair of thicker ones. Parastigmatic vessels present. Four to six stigmata in a mesh. Tentacles 18-28, large and small ones alternate rather regularly. Dorsal tubercle very large, 4.5 mm in length in 61 mm long individual. Ciliated groove U-shaped, with horns complexly undulating. Dorsal lamina a tall plain membrane.

Alimentary system: Stomach without plication, not much thicker than the following intestine. Anus finely lobed.

Gonad: Completely buried in the mantle, merely apertures being observable on the surface. They seem to be distributed rather evenly on both sides.

21. *Microcosmus helleri* HERDMAN 1881

(Fig. 23)

Microcosmus helleri; HERDMAN (1882): Rep. Voy. Challenger, Vol. 6, Tunicata, pp. 131-132, Pl. XIV, figs. 1-4.

TRAUSTEDT (1885): Vid. Meddel. fra naturh. Foren., ann. 1884, p. 41.

SLUITER (1895): Semon Zoolog. Forschungsreisen, V. p. 184, Pl. X, figs. 8 & 9.

HARTMEYER (1919): Kungl. Sv. Vetensk. Handl., Bd. 60, No. 4, pp. 19-26, Pl. I, figs. 6-9.

VAN NAME (1921): Bull. American Mus. Nat. Hist., Vol. XLIV, pp. 463-466, Figs. 145-146.

VAN NAME (1924): Bijl. Dierk., Afl. XXIII, p. 31.

HASTINGS (1931): Great Barrier Reef Exped., Vol. IV, No. 3, p. 72.

VAN NAME (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 349-351, Fig. 232, Pl. 10, fig. 5.

Two specimens were collected by Mr. S. WADA. The larger one is 70 mm long and the smaller one is 35 mm in length. Body oval in shape. The larger specimen attached to the substratum by its right posterior part of the body and seems to be lying with its right side beneath, while the smaller one attached by the posterior end of the body. Branchial aperture terminal, atrial aperture about the middle of the body or situated more posteriorly. Each aperture on a low prominence and 4-lobed. Test leathery and rather thin, about 1 mm in thickness, but very strong and tough and pinkish brown to

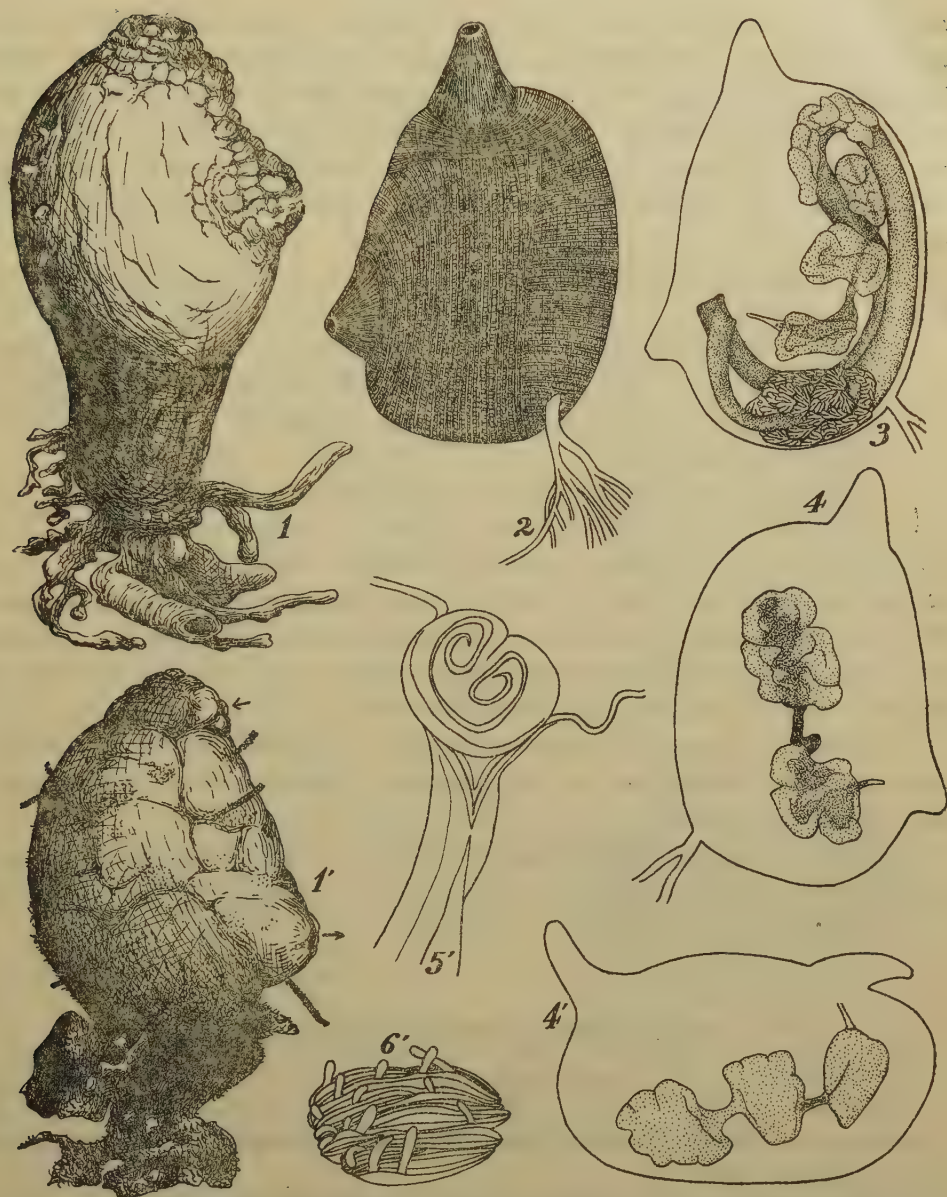


Fig. 23. *Microcosmus holleri* HERDMAN. 1-4: 70 mm long individual; 1', 4'-6': 35 mm long individual. 1—Entire animal from left side, 2—Mantle body from right side, 3—Left half from inside, 4—Right half from inside, 5—Dorsal tubercle $\times 12$, 6—A part of liver, magnified.

grayish brown in colour. It is wrinkled irregularly around the apertures and in the posterior part of the body, while the other part is rather smooth ex-

cepting a few faint grooves. The inner surface of test pale pinkish brown. Some hydrozoans, didemnids etc. are found on the surface. Mantle reddish brown in colour and not thick. Muscular bands arranged very regularly: longitudinal bands outside the transverse ones on the dorsal half of the body, while the arrangement of muscular bands is entirely reversal on the ventral half. On the mantle body, the atrial siphon is placed near the posterior end of the body.

Branchial sac: Six folds on each side. Inner longitudinal vessels arranged as follows:

70 mm long individual:

Left	D.	5	(25)	7	(19)	6	(20)	6	(15)	5	(13)	4	(8)	2	V.
Right	D.	5	(21)	6	(18)	6	(20)	5	(19)	6	(14)	5	(9)	3	V.

35 mm long individual:

Left	D.	5	(27)	5	(23)	5	(20)	6	(16)	5	(13)	4	(10)	2	V.
Right	D.	5	(25)	5	(20)	5	(22)	5	(21)	4	(17)	5	(15)	2	V.

Seven to fifteen thinner transverse vessels, classified roughly in three orders, between each pair of thicker ones. Parastigmatic vessels present. Five to seven stigmata in a mesh. Tentacles 14-15 excluding minute ones, large and small ones alternate regularly; branches in two orders. Ciliated groove U-shaped, with its horns strongly curled in.

Alimentary system: Intestinal loop long and narrow. Several small endocarps found on the bending part of intestine. Liver forms a compact group. Anus plainly margined.

Gonad: The right gonad consists of two-three capsules, while the left gonad of three capsules.

22. *Microcosmus propinquus* HERDMAN 1881

(Fig. 24 and Fig. 25-5')

Microcosmus propinquus; HERDMAN (1882): Rep. Voy. Challenger, Vol. VI, Tunicata, pp. 132-133, Pl. XIV, figs. 5 & 6.

TRAUSTEDT (1885): Vid. Meddel. fra naturh. Foren., ann. 1884, p. 42.

SLUITER (1904): Siboga Exped., Monogr. 56 a, p. 51.

Seven specimens collected by Mr. S. WADA were at my disposal. The largest one is 22 mm in length, while the smallest one only 8 mm long. Body roughly oval, with short branchial siphon at terminal and atrial siphon of about the same length nearly at the middle of the body. It is attached by its right ventral or right postero-ventral side of the body. Test leathery and



Fig. 24. *Microcosmus propinquus* HERDMAN. 1—Entire animal from left side, 2—Mantle body of a small individual from left side, 3—Right half from inside, 4—Left half from inside, 5—Dorsal tubercle of a small individual×45, 6—Dorsal tubercle of a large individual×28, 7—A part of branchial sac×45, 8—A part of liver, magnified.

rather thick, reddish brown in colour and with some foreign matters adhered on the surface. Surface nearly smooth excepting a few slight wrinkles on larger individuals. Inner surface of test pearly white or grayish white. Mantle reddish brown to brick red in colour and considerably thick, muscular bands arranged very regularly. Atrial tentacles present. Many spinules (ca. 60μ long) on the inner surface of siphons (Fig. 25-5').

Branchial sac: Six to eight folds are present. Inner longitudinal vessels

arranged as follows:

22 mm long individual:

Left D. 2 (18) 3 (13) 3 (21) 3 (18) 3 (14) 2 (14) 1 (13) 0 V.

Right D. 2 (23) 1 (18) 2 (23) 2 (20) 2 (16) 3 (13) 1 (6) 0 V.

16 mm long individual:

Left D. 2 (17) 1 (15) 2 (16) 2 (16) 2 (15) 2 (12) 2 (11) 1 V.

Right D. 0 (16) 1 (15) 2 (17) 2 (18) 2 (16) 2 (15) 2 (11) 2 (4) 1 V.

12 mm long individual:

Left D. 1 (16) 1 (13) 1 (16) 2 (16) 1 (13) 1 (12) 1 (11) 0 V.

Right D. 1 (15) 1 (12) 1 (16) 2 (13) 2 (13) 3 (7) 1 (3) 0 V.

8 mm long individual:

Left D. 1 (13) 1 (8) 1 (15) 1 (15) 1 (10) 1 (8) 1 (5) 1 V.

Right D. 1 (17) 1 (8) 1 (13) 1 (12) 1 (11) 1 (8) 0 V.

10 mm long individual (Body proper 6 mm long, peduncular extension of test 4 mm):

Left D. 0 (13) 0 (5) 1 (11) 1 (9) 0 (8) 0 (1) 0 V.

Right D. 0 (12) 0 (5) 1 (10) 1 (11) 1 (10) 1 (8) 1 V.

About 3 thinner transverse vessels between each pair of thicker ones. Parastigmatic vessels present. Three stigmata in a mesh. Tentacles ca. 35 excluding minute ones, branches in 2 orders. Ciliated groove U-shaped, with anterior horns strongly incurled in large individuals. Prebranchial area papillated. Many small papillae on inner longitudinal vessels in some individuals. Besides, many papillae are found along the left side of endostyle, especially remarkably in smaller individuals.

Alimentary system: Liver yellowish brown. Some small endocarps on intestine behind the liver. Anus plainly margined.

Gonad: Three-four genital capsules on the right and four to five ones on the left side.

23. *Microcosmus exasperatus* HELLER 1878

(Fig. 25)

Microcosmus variegatus; TRAUSTEDT (1885): Vid. Meddel. fra naturh. Foren., Foren., ann. 1884, pp. 42-43.

Microcosmus miniatus; VAN NAME (1902): Trans. Connecticut Acad. Sci., Vol. 11, pp. 396-397, Pl. 56, fig. 79; Pl. 57, figs. 91-95; Pl. 62, figs. 129-180; Pl. 64, fig. 148.

Microcosmus exasperatus; VAN NAME (1918): U. S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 81-83, Figs. 30-32, Pl. 32, fig. 29.

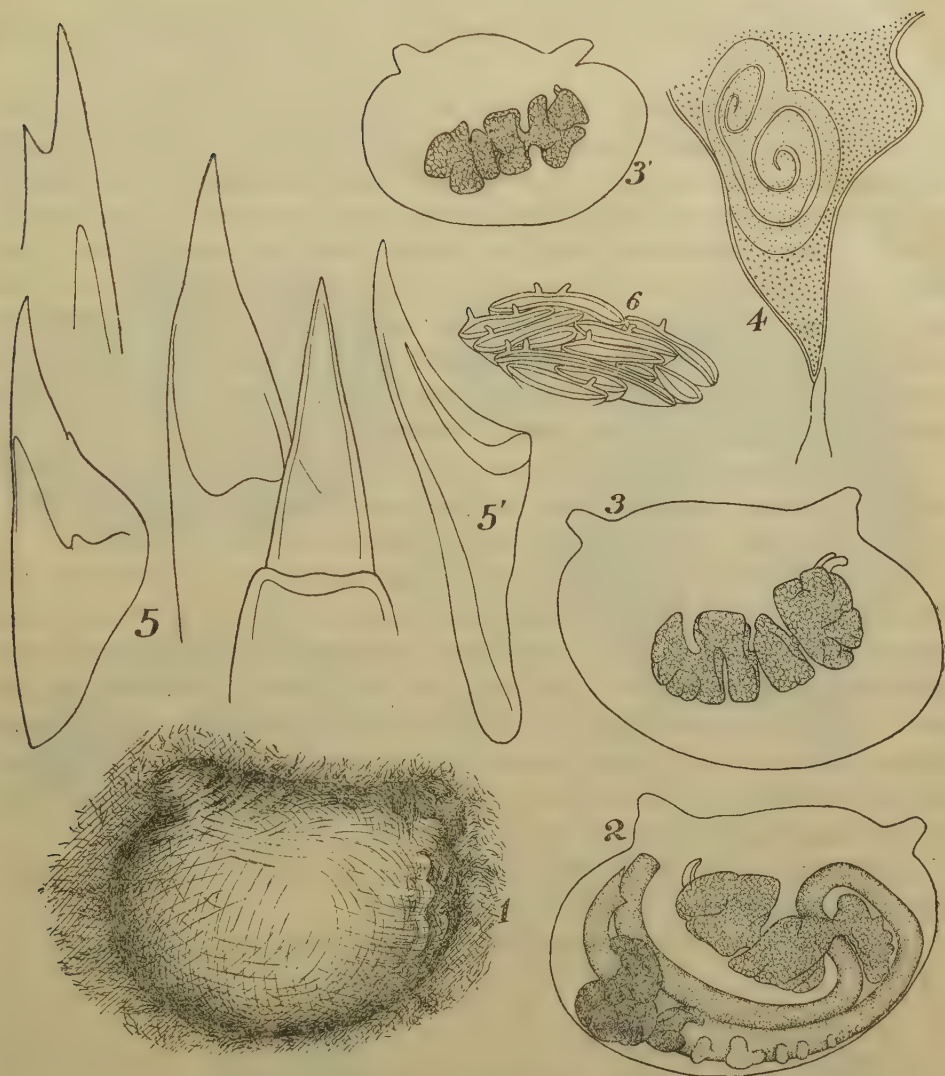


Fig. 25 *Microcosmus exasperatus* HELLER, except 5' which shows a spinule ($\times 1200$) from the inner surface of siphons in *Microcosmus propinquus* HERDM. 1—Entire animal from left side, 2—Left half of 32 mm long individual from inside, 3—Right half of the same from inside, 3'—Right half of 19 mm long individual from inside, 4—Dorsal tubercle $\times 12$, 5—Spinules from the inner surface of siphons $\times 200$, 6—A part of liver, magnified.

VAN NAME (1921): Bull. American Mus. Nat. Hist., Vol. XLIV, pp. 459-462, Figs. 137-144.

VAN NAME (1924): Bijdr. Dierk., Afl. XXIII, p. 31.

BERRILL (1932): Biol. Bull., Vol. 62, p. 78.

VAN NAME (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 346-349, Figs. 230-231, Pl. 16, fig. 3.

Three specimens collected by Mr. R. WADA. The largest one 32 mm and the smaller ones 19 mm in length. Body oval, attached to the shell surface by its whole right side or right ventral side. Branchial aperture subterminal, atrial aperture situated about $\frac{1}{3}$ the body length from the posterior end of the body. Both apertures 4-lobed and opened each on a short siphon. Test red, leathery and very strong, although it is not thick. Inner surface of test pearly white. Mantle is not thick and grayish yellow to pale yellowish orange, muscular bands arranged regularly to form a neat cross stripes on the dorsal half. Minute atrial tentacles are present. Many spinules (less than 300μ in length) on the inner surface of siphons.

Branchial sac: Nine folds on the right and eight folds on the left side. Inner longitudinal vessels arranged as follows in 32 mm long individual.

Left D. 5 (22) 4 (21) 5 (25) 5 (24) 5 (25) 5 (24) 4 (18) 2 (12) 0 V.

Right D. 2 (24) 5 (24) 4 (26) 4 (27) 4 (27) 5 (25) 4 (21) 4 (19) 1 (11) 0 V. Three to seven thinner transverse vessels between each pair of thickner ones. Parastigmatic vessels present. Many prominent papillae along the transverse vessels on the outer surface of the branchial sac. Four to six stigmata in a mesh. Tentacles 16, large and small ones alternate regularly, branches in two orders. Ciliated groove horse-shoe-shaped, opening towards the left side and with its horns strongly curled in. Edge of dorsal lamina plain. Prebranchial area and also the dorsal tubercle are papillated.

Alimentary system: Several small endocarps behind the liver which is dark brownish in colour. Margin of anus plain.

Gonad: Three capsules on the left and 4-5 ones on the right side.

24. *Microcosmus multiplicatus* n. sp.

(Fig. 26)

A 47 mm long specimen was found by Mr. S. WADA. Body nearly globular, with siphons bending towards the right side which is somewhat flattened and covered with very thin test. The left side of the body is covered with didemnids, bryozoans and hydrozoans etc. The animal seems to be lying with its right side beneath. Branchial aperture terminal, atrial aperture at the middle of the body. Both apertures 4-lobed and each on a low prominence.

Test leathery, thin, but very strong and reddish brown in colour, with some pearly glistening on the inner surface. Mantle fleshy in colour, muscular bands form a cross stripes on the dorsal half. Delicate atrial tentacles are present. Spinules, less than 350μ in length, are found on the inner surface of siphons.

Branchial sac: Eleven folds on the right and twelve ones on the left side. Inner longitudinal vessels arranged as:

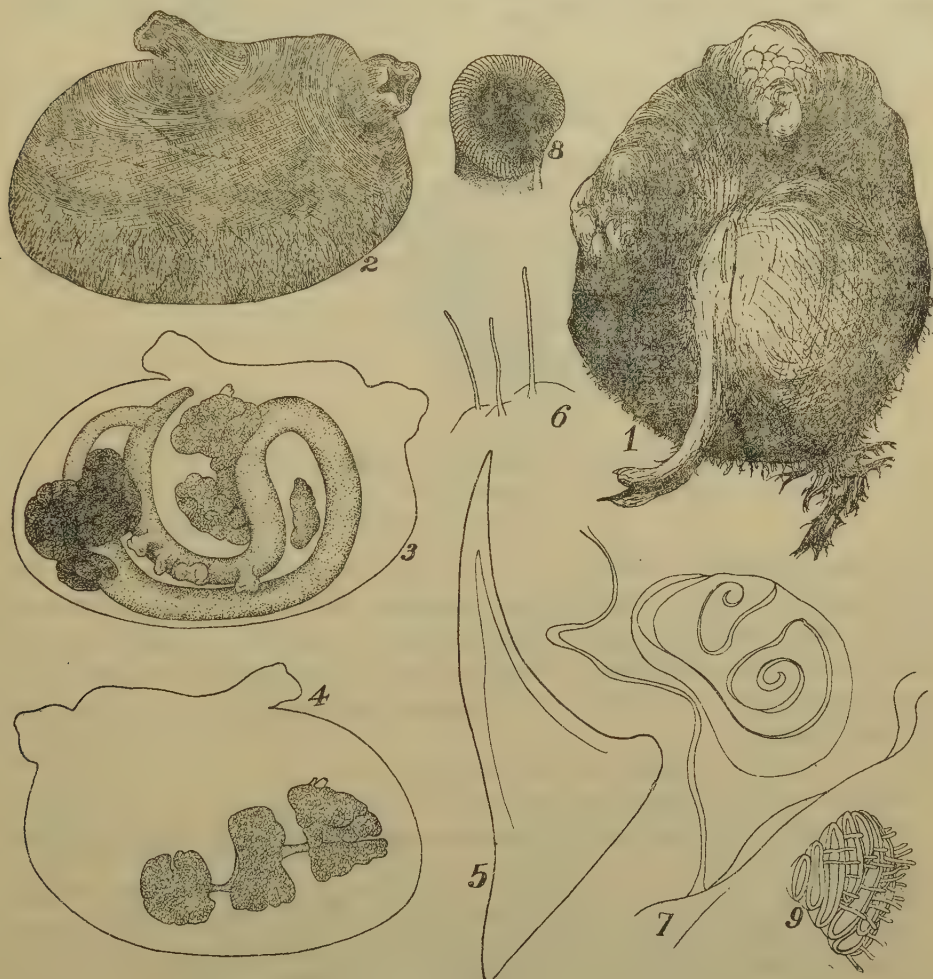


Fig. 26. *Microcosmus multiplicatus* n. sp. 1—Entire animal from right side, 2—Mantle body from right side, 3—Left half from inside, 4—Right half from inside, 5—A spinule from the inner surface of siphons $\times 200$, 6—Atrial tentacles $\times 45$, 7—Dorsal tubercle $\times 12$, 8—Anus, 9—A part of liver $\times 12$.

Left	D.	5	(20)	5	(28)	8	(26)	7	(28)	7	(28)	7	(24)	6	(22)
				6	(18)	7	(16)	4	(13)	3	(8)	2	(4)	2+V.	
Right	D.	5	(23)	5	(28)	5	(28)	7	(28)	8	(27)	8	(27)	6	(21)
				6	(17)	6	(14)	3	(13)	3	(5)	1	V.		

Three to seven transverse vessels between each pair of thicker ones. Parastigmatic vessels present. About 6 stigmata in a mesh. Tentacles 21 excluding minute ones, large and small ones alternate regularly, branches in 3 orders. Pretentacular area papillated. Dorsal tubercle rosette-formed. Edge of dorsal lamina plain.

Alimentary system: Several small endocarps at the bending portion of the second intestinal loop. Anus finely lobed.

Gonad: Three genital capsules on each side.

Remarks: The present specimen is possibly a form of *M. exasperatus*, which is provided with too numerous branchial folds for this species. For the present, however, it seems to be convenient for recording materials to give a new name to the present specimen provisionally.

25. *Pyura vittata* (STIMPSON) 1852

(Fig. 27)

Halocynthia rubrilabia + *Halocynthia riiseana* var. *munita*; VAN NAME (1902): Trans. Connecticut Acad. Art. Sci., Vol. XI, pp. 393-395, Pl. 56, figs. 83 & 84; Pl. 57, figs. 85-87 & 90; Pl. 62, fig. 133; Pl. 63, fig. 141; Pl. 64, figs. 150 & 152.

Halocynthia karasboja; OKA (1906): Annot. Zool. Japon., Vol. VI, Pt. 1, pp. 48-49.

Pyura vittata; VAN NAME (1921): Bull. American Mus. Nat. Hist., Vol. XLIV, pp. 446-451, Figs. 112-122.

VAN NAME (1924): Bijl. Dierk., Afl. XXIII, p. 31.

BERRILL (1932): Biol. Bull., Vol. 62, p. 78

VAN NAME (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 321-335, Figs. 213-215, Pl. 16, fig. 5.

PERÈS (1949): Bull. l'Inst. franç. Afrique noire, Tom. XI, p. 195.

TOKIOKA (1949): Publ. Seto Mar. Biol. Lab., I (2), p. 59, Fig. 13.

TOKIOKA (1950): Publ. Seto Mar. Biol. Lab., I (3), pp. 146-147, Fig. 21.

Cynthia vittata; OKA (1935): Sci. Rep. Tôhoku Imp. Univ., 4th Ser., Vol. X, pp. 439-440, Figs. 8 & 9.

A small 13 mm long individual was found in the colony of *Stolonica (Amphicarpha) sigma*. Body oval, with apertures at the dorsal side. Each apertures 4-lobed and marked with 4 dark greenish striations converging to the aper-

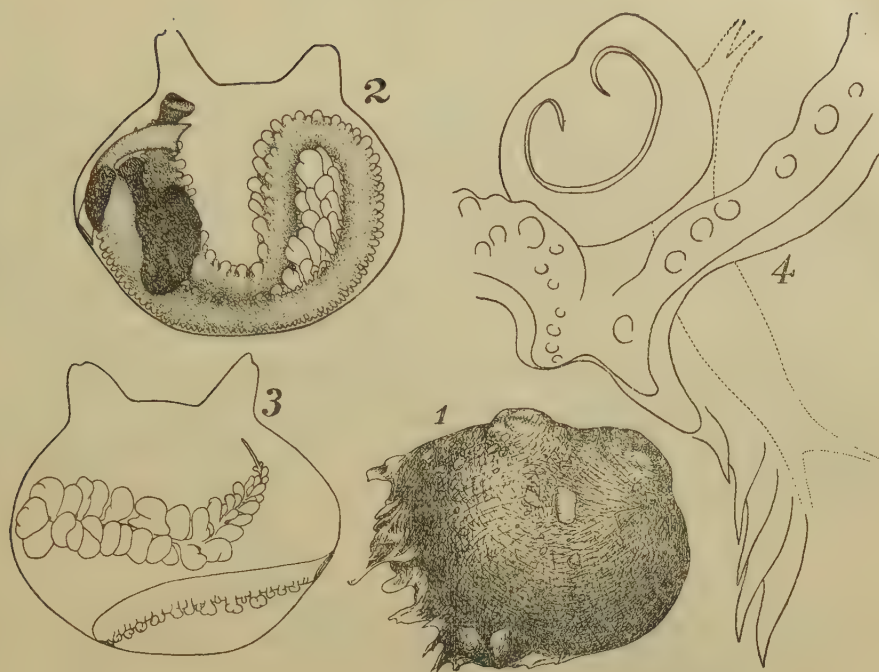


Fig. 27. *Pyura vittata* (STIMPSON). 1—Entire animal from right side, 2—Left half from inside, 3—Right half from inside, 4—Dorsal tubercle and dorsal languets $\times 45$.

tures. Test yellowish white, leathery, of moderate thickness and with some foreign matters on the surface. Mantle thin, translucent and salmon in colour. Atrial velum well developed.

Branchial sac with 6 folds on each side. Inner longitudinal vessels arranged as:

Left D. 3 (14) 4 (15) 3 (16) 4 (16) 4 (15) 4 (12) 4 V.

Right D. 5 (15) 4 (16) 4 (18) 4 (18) 4 (17) 3 (13) 3 V.

Three to seven thinner transverse vessels between each pair of thicker ones. Parastigmatic vessels present. About 3 stigmata in a mesh. Tentacles 16, arranged—large—small—medium—small—large—, branches in 2 orders. Ciliated groove U-shaped, with anterior horns slightly incurled. Anus plainly margined. Gonad immature.

26. *Pyura elongata* n. sp.

(Fig. 28)

One specimen was found by Mr. R. WADA. It is 24 mm long $\times$ 15 mm wide with 9 mm height. Body elongate oval and attached by whole ventral side. Branchial aperture terminal, atrial aperture subterminal near the opposite side of the branchial. Both apertures 4-lobed and marked with orange colour. Test yellowish white in colour and wrinkled irregularly. It is much thicker on the dorsal side than on the ventral side. Mantle grayish yellow and of moderate thickness. Muscular bands arranged regularly to form a fine cross stripes on the dorsal side. Atrial velum well developed. Minute spinules on the inner surface of the distal part of the branchial siphon.

Branchial sac: Six folds on each side. Inner longitudinal vessels arranged as follows:

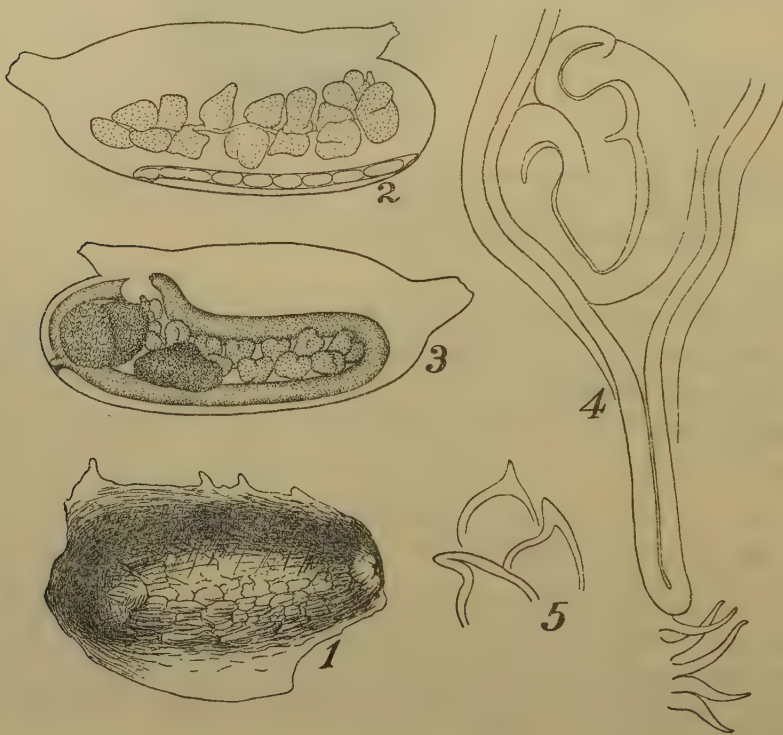


Fig. 28. *Pyura elongata* n. sp. 1—Entire animal from dorsal side, 2—Right half from inside, 3—Left half from inside, 4—Dorsal tubercle $\times$ 45, 5—Spinules from the inner surface of the branchial siphon $\times$ 1200.

Left	D.	0	(20)	2	(23)	2	(24)	3	(24)	3	(18)	4	(13)	5	V.
Right	D.	0	(17)	2	(23)	2	(24)	2	(27)	3	(22)	2	(17)	5	V.

Three to seven thinner transverse vessels between each pair of thicker ones. Parastigmatic vessels present. Two-three stigmata in a mesh. Tentacles 37 in all, branches in 2 orders. Ciliated groove U-shaped.

Alimentary system: Intestinal loop of a uniform width. Each branch of the loop runs parallel to each other. Liver yellow-yellowish white in colour and divided into anterior and posterior groups, the former of which consisting of two lobes. Margin of anus plain.

Gonad: As in common pyurids.

Remarks: At a glance this new species resembles closely *P. mirabilis* (v. DRASCHE), *P. subuculata* (SLUITER) and *P. shiinoi* TOKIOKA in the appearance of the alimentary canal and liver, but differs distinctly from these species in having 6 branchial folds instead of 7 and tentacles with branches in 2 orders.

27. *Herdmania momus* (SAVIGNY) 1816

(Fig. 29)

Cynthia pallida; HERDMAN (1882): Rep. Voy. Challenger, Vol. VI, Tunicata, p. 143, Pl. XVII, figs. 17-21.

TRAUSTEDT (1885): Vidensk. Meddel. fra naturh. Foren., ann. 1884, p. 35.

Cynthia pallida+*C. pallida* var. *billitonensis*; HERDMAN (1886): Rep. Voy. Challenger, Vol. XIV, Tunicata, App. A., pp. 405-406.

Cynthia pallida var. *billitonensis*; SLUITER (1890): Natuurk. Tijdschr. Ned.-Ind., Vol. 50, p. 331.

Rhabdocynthia pallida; SLUITER (1897): Zool. Jahrb., Syst., Vol. 11, p. 7.

SLUITER (1904): Siboga Exped., Monogr. 56 a, pp. 54-55.

HERDMAN (1906): Ceylon Pearl Oyster Fish., Suppl. Rep., No. 39, p. 308, Pl. 2, figs. 36-39.

Halocynthia pallida; HARTMEYER (1905): Zool. Jahrb., Syst. Suppl., Bd. 8, p. 384.

MICHAELSEN (1905): Zool. Jahrb., Syst. Suppl., Bd. 8, pp. 78-85, Taf. 4 fig. 11.

HARTMEYER (1906): Zool. Anz., Bd. 31, p. 4, Fig. 2.

Pyura pallida; HARTMEYER (1911): Bronn. Tier-Reich., Bd. III, Suppl. p. 1340.

HARTMEYER (1912): Deutsche Tiefsee-Exped., Bd. 16, pp. 361-363.

VAN NAME (1918): U. S. Nat. Mus. Bull. 100, Vol. 1, Pt. 2, pp. 76-79, Figs. 19-25, Pl. 32, figs. 36-38.

Pyura momus var. *pallida*; MICHAELSEN (1921): Ark. f. Zool., Bd. 13, No. 23, pp. 1-2.

Pyura (*Rhabdocynthia*) *momus* form *pallida*; VAN NAME (1921): Bull. American Mus. Nat. Hist., Vol. XLIV, pp. 454-459, Figs. 129-136.

Herdmania momus; VAN NAME (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 341-344, Figs. 225 & 226.

TOKIOKA (1949): Publ. Seto Mar. Biol. Lab., I (2), pp. 61-62, Fig. 15, Pl. VIII, figs. 5 & 6.

TOKIOKA (1950): Publ. Seto Mar. Biol. Lab., I (3), p. 150, Fig. 23-5.

Rhabdocynthis ceylonica; HERDMAN (1906): Ceylon Pearl Oyster Fish., Suppl. Rep., No. 39.

Pyura pallida f. *ceylonica*, HARTMEYER (1911): Bronn. Tier-Reich., Bd. III, Suppl., p. 1340.

Pyura momus f. *galei*; MICHAELSEN (1927): Zool. Anz., Bd. 71, pp. 194-195.

Cynthia complanata; HERDMAN (1882): Rep. Voy. Challenger, Vol. VI, Tunicata, pp. 145-146, Pl. XVII, figs. 1-9.

Microcosmus Draschii; HERDMAN (1899): Descriptive Catalogue of the Tunicata in the Australian Museum, pp. 20-23, Pl. Cyn. III & IV.

Halocynthia grandis; MICHAELSEN (1905): Zool. Jahrb., Syst. Suppl., Vol. 8, pp. 85-91.

Pyura pallida f. *grandis*; HARTMEYER (1911): Bronn. Tier-Reich., Bd. III, Suppl., p. 1340.

Pyura momus f. *grandis*; HASTINGS (1931): Great Barrier Reef Exped., Sci. Rep., Vol. IV, No. 3, p. 72.

Pyura pallida f. *japonica*; HARTMEYER (1911): Bronn. Tier Reich., Bd. III, Suppl. p. 1340.

Cynthia papietensis; HERDMAN (1882): Rep. Voy. Challenger, Vol. VI, Tunicata, pp. 143-145, Pl. XVII, figs. 10-16.

Pyura pallida f. *papietensis*; HARTMEYER (1911): Bronn. Tier-Reich., Bd. III, Suppl., p. 1340.

Rhabdocynthis tenuis; HERDMAN (1891): Jnl. Linn. Soc. Zool., Vol. XXIII.

Pyura pallida f. *tenuis*; HARTMEYER (1911): Bronn. Tier-Reich., Bd. III, Suppl., p. 1340.

Forty-five mm long and 25 mm long individuals collected by Mr. S. WADA were at my disposal. Test pinkish to light red in the preserved state, semi-transparent, soft cartilaginous and 1-2 mm in thickness. The surface with irregular grooves and folds and adheres some foreign matters such as sand grains and shell fragments. Siphons distinct in the larger individual, while quite obscure in the smaller individual. Both apertures 4-lobed. Mantle pinkish and thin. Branchial sac with 9 folds on each side and with the following vessel-formula.

45 mm long individual;

Left	D.	13	(19)	5	(19)	5	(26)	5	(29)	5	(29)	5	(28)	5	(22)
										5	(14)	4	(3)	1	V.

Right D. 10 (16) 5 (25) 5 (28) 5 (29) 5 (30) 6 (27) 5 (26)
6 (14) 5 (4) 2 V.

25 mm long individual:

Left D. 8 (18) 4 (22) 3 (25) 3 (22) 5 (21) 5 (18) 5 (18)
4 (9) 3 (4) 1 V.

Right D. 6 (17) 4 (19) 4 (24) 4 (24) 3 (22) 4 (18) 4 (17)
3 (12) 3 (4) 1 V.

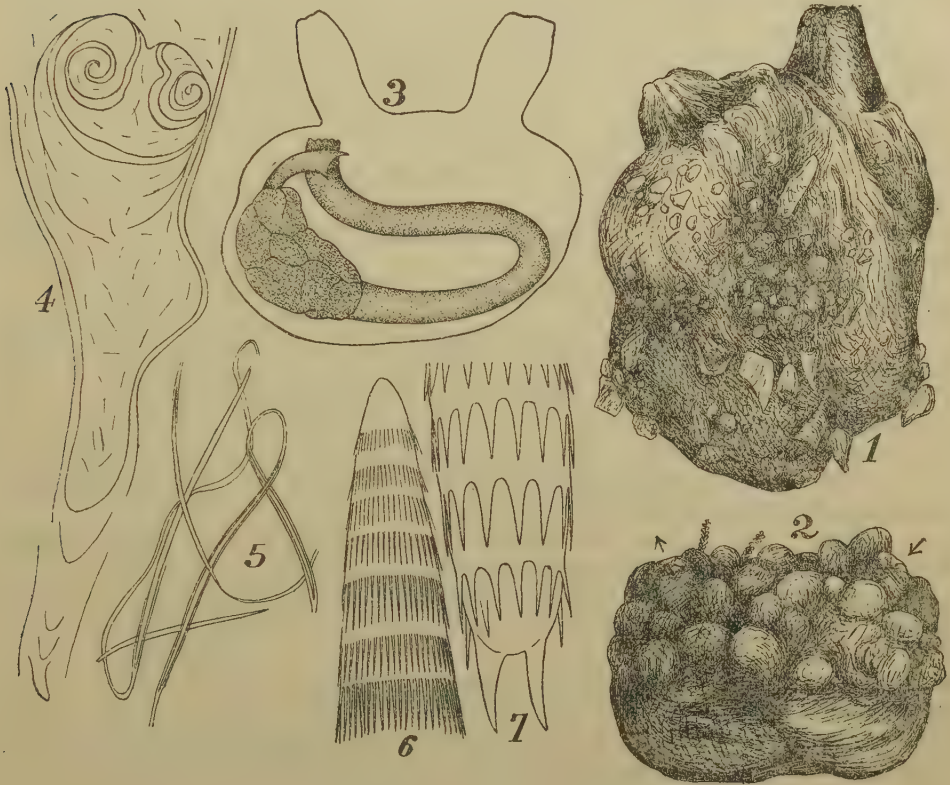


Fig. 29. *Herdmania momus* (SAVIGNY). 1—45 mm long individual from right side 2—25 mm long individual from right side, 3—Right half from inside, 4—Dorsal tubercle $\times 12$, 5—Spicules in sheaths $\times 28$, 6—Acute tip of a spicule $\times 1200$, 7—Blunt tip of a spicule $\times 1200$.

About 7 thin vessels between thick ones. Parastigmatic vessels present. Four to five stigmata in a mesh. Tentacles 23, excluding minute ones, in larger specimen; branches in 4 orders. Margin of anus lobated. Gonad not found in both specimens.

LITERATURE

- ALDER, J. & HANCOCK, A. (1907): The British Tunicata, Vol. II. pp. 164, Figs. 86, Pls. 21-50.
- BERRILL, N. J. (1932): Ascidiæ of the Bermudas, Biol. Bull., Vol. 62, pp. 77-88, Figs. 1-5.
- BOVIEN, P. (1921): Ascidiæ from the Auckland and Campbell Islands, Vid. Meddel. Dansk. naturh. Fören., Bd. 73, pp. 33-47, Figs. 1-5, Pl. 4.
- BREWSTER, B. I. (1950): Ascidiæ from Otago Coastal Waters, Trans. Roy. Soc. New Zealand, Vol. 78, Pt. 1, pp. 54-63, Figs. 1-5.
- (1950): Ascidiæ of New Zealand Part IV. Ascidiæ in the Vicinity of Christchurch, Trans. Roy. Soc. New Zealand, Vol. 78, Pt. 2-3, pp. 344-353, Figs. 1-5.
- (1950): Ascidiæ of New Zealand Part V. Ascidiæ from the East Coast of Great Barrier Island, Trans. Roy. Soc. New Zealand, Vol. 78, Pt. 2-3, pp. 354-362, Figs. 1-7.
- (1950): The Ascidiæ of the Sub-antarctic Islands of New Zealand, Cape Expedition Series, Bull. No. 11, pp. 11, Figs. 1-3.
- GOTTSCHALDT, R. (1898): Synascidien von Ternate, Abh. Senckenb. naturf. Ges., Bd. 24, pp. 641-660, Taf. 35-36.
- HARTMEYER, R. (1900): Monascidien von Ternate, Abh. Senckenb. naturf. Ges., Bd. 25, pp. 3-12, Taf. 1.
- (1900): Nachtrag zu Monascidien von Ternate, Abh. Senckenb. naturf. Ges., Bd. 25, pp. 235-242, Taf. X.
- (1905): Ascidien von Mauritius, Zool. Jahrb. Syst. Suppl., Bd. 8 pp. 386-406, Pl. 13, Figs. A-C.
- (1906): Ein Beitrag zu Kenntniss der japanischen Ascidiæfauna, Zool. Anz., Bd. 31, pp. 1-30, Figs. 1-12.
- (1909-1911): Ascidien in Bronn's Tier-Reich, Bd. 3, Suppl. pp. 1280-1773, 41 Pls.
- (1911): Die Ascidien der deutschen Südpolar-Expedition, 1901-1903; Deutsch. Südpolar-Exped., Bd. 12, pp. 403-506, Taf. 45-57, Figs. 1-14.
- (1912): Die Ascidien der deutschen Tiefsee-Expedition, Wiss. Ergeb. Deutsch. Tiefsee-Exped., Bd. 16, pp. 225-392, Taf. 37-44, Figs. e-10, 2 Maps.
- (1919): Results of Dr. Mjöberg's Swedish Scientific Expeditions to Australia 1910-13. XXV Ascidien, Kungl. Svensk. Vetenskapsakad. Handl. Bd. 60, No. 4, pp. 1-150, Figs. 1-25, 2 Pls.
- HASTINGS, A. B. (1931): Tunicata in Great Barrier Reef Exped., Sci. Rep., Vol. IV, No. 3, pp. 69-110, Pls. I-III, Figs. 1-17.
- HERDMAN, W. A. (1882): Report on the Tunicata collected during the Voyage of H.M.S. Challenger during the years 1873-1876. Part I. Ascidiæ Simplicæ, Rep. Voy. Challenger, Zool. Vol. VI, Part 17 Tunicata, pp. 1-296, Pls. 1-37.
- (1886): Report on the Tunicata collected during the Voyage of H.M.S. Challenger during the years 1873-1876. Part II. Ascidiæ Compositæ, Rep. Voy. Challenger, Zool. Vol. XIV Tunicata, pp. 1-432, Pls. 1-49.
- (1891): A revised Classification of the Tunicata, Jnl. Linn. Soc. Zool., Vol. XXIII, pp. 558-652.
- (1899): Descriptive Catalogue of the Tunicata in the Australian Museum, Liverpool, xviii+139 pp., 45 Pls.
- (1906): Report on the Tunicata collected by Prof. Herdman at Ceylon in 1902, Rep. Ceylon Pearl Oyster Fish., Pt. 5, Suppl. Rep. No. 39, pp. 295-348, Pls. 1-9.
- HUUS, J. (1937): Ascidiaceæ in Kükenthal & Krumdach: Handb. d. Zool., Bd. 5 Tunicata, pp. 545-692, Figs. 454-581.

- KESTEVENS, H. L. (1909): Studies on Tunicata. No. 1, Proc. Linn. Soc. New South Wales, Vol. 34, pp. 276-295, Pls. 25-27.
- MICHAELSEN, W. (1904): Die stolidobranchiaten Ascidien der deutschen Tiefsee-Expedition, Wiss. Ergebn. Deutsche. Tiefsee Exped., Bd. 7, pp. 181-260, Pls. 10-13.
- (1905): Revision von Hellers Ascidientypen aus dem Museum Godeffroy, Zool. Jahrb., Syst. Suppl., Bd. 8, pp. 71-120, Pls. 4.
- (1921): Ascidien vom westlichen Indischen Ozean aus dem Reichsmuseum zu Stockholm, Ark. f. Zool., Bd. 13, No. 23, pp. 1-25, Taf. 1.
- (1922): Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. XI. Ascidiæ Ptychobranchiæ und Diktyobranchiæ von Neuseeland und den Chatham Inseln, Vidensk. Medd. fra Dansk naturh. Foren., Bd. 73, pp. 359-498, Figs. 35.
- (1924): Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. XXII Ascidiæ Krikobranchiæ von Neuseeland, den Chatham und den Auckland Inseln, Vidensk. Medd. fra Dansk naturh. Foren., Bd. 77, pp. 263-434, Figs. 30.
- (1927): Einige neue westaustralische Ptychobranchiate Ascidien, Zool. Anz., Bd. 71, pp. 193-203.
- OKA, A. (1906): Notizen über japanische Ascidien I, Annot. Zool. Japon., Vol. VI, Pt. 1, pp. 37-52.
- (1915): Report upon the Tunicata in the Collection of the Indian Museum, Mem. Indian Mus., Vol. VI, pp. 1-33, Pls. I-V.
- (1935): Report of the Biological Survey of Mutsu Bay. 28 Ascidiæ Simplicæ, Sci. Rep. Tôhoku Imp. Univ. 4th Ser., Vol. X, pp. 427-463, Figs. 1-35.
- PÈRES, J. M. (1949): Contribution à l'étude des Ascidiæ de la côte occidentale d'Afrique, Bull. l'Inst. franc. d'Afrique noire, Tom. XI, pp. 159-207, Figs. 1-27.
- PIZON, A. (1908): Ascidiæ d'Amboine, Rev. Suiss. Zool., Tom. 16, pp. 195-240, Pls. 9-14.
- RITTER, W. E. & FORSYTH, R. A. (1917): Ascidians of the littoral zone of southern California, Univ. California Publ. Zool., Vol. 16, pp. 439-512, Pls. 38-46.
- SALFI, M. (1931): Gli Ascidiacei del Golfo di Napoli, Pubbl. Staz. Zool. Napoli, Vol. XI, Fasc. 3, pp. 293-360, Pls. VI-X, Figs. 49.
- SLUITER, C. PH. (1885): Ueber einige einfache Ascidien von der Insel Billiton, Natuurk. Tijdschr. Ned. Ind., Vol. 45, pp. 160-232, Pls. 1-9.
- (1886): Einfache Ascidien aus der Bai von Batavia, Natuurk. Tijdschr. Ned.-Ind., Bd. 46, pp. 242-266, Pls. 1-3.
- (1890): Die Evertibraten aus der Sammlung des Kgl. naturw. Vereins in Nederl. Ind. in Batavia. Zugleich eine Skizze der Fauna des Java Meeres mit Beschreibung der neuen Arten Ascidiæ Simplicæ, Natuurk. Tijdschr. Ned. Ind., Bd. 50, pp. 329-348, Pls. 1 & 2.
- (1895): Tunicata in Semon Zoologische Forschungsreisen in Australien, etc. Bd. 5, Denkschr. med. naturwiss. Gesell. Jena, Bd. 2, pp. 163-186, Figs. 5, Pls. 8.
- (1897): Tunicata von Südafrika (Beiträge zur Kenntniss der Fauna von Südafrika II), Zool. Jahrb. Syst., Bd. 11.
- (1900): Tunicaten aus dem Stillen Ozean, Ergebnisse einer Reise nach dem Pacific, Zool. Jahrb., Syst., Bd. 13, pp. 1-35, Pls. 1-6.
- (1904): Die Tunicaten der Siboga-Expedition. Pt. 1 Die sozialen und holosomen Ascidien, Siboga Exped., Monogr. 56 a, pp. 1-126, Pls. 1-15.
- (1909): Die Tunicaten der Siboga-Expedition. Pt. 2 Die Merosomen Ascidien, Siboga-Exped., Monogr. 56 b, pp. 1-112, Pls. 1-8, Figs. 1 & 2.
- (1914): Ascidien von den Aru-Inseln, Abhandl. Senckenberg. Naturforsch. Gesell., Bd. 35, Hft. 1, pp. 65-78, Pls. 5 & 6.
- (1919): Ueber einige alte und neue Ascidien aus dem Zoologischen Museum von Amsterdam, Bijd. Dierk., Afl. XXI, pp. 1-12, Pl. 1.

- TOKIOKA, T. (1942): Ascidiens found on the Mangrove Trees in Iwayama Bay, Palao, Palao Tropical Biol. Stat. Studies, Vol. II, No. 3, pp. 497-506, Pl. IV, Figs. 1 & 2.
- (1949): Contributions to the Japanese Ascidian Fauna I. Ascidiens collected by Prof. Miyadi and Mr. Masui during the Bottom Survey 1939-40, Publ. Seto Mar. Biol. Lab., I (1), pp. 1-17, Pls. 1-7.
- (1949): Contributions to Japanese Ascidian Fauna II. Notes on some Ascidiens collected chiefly along the coast of Kii Peninsula, Publ. Seto Mar. Biol. Lab., I (2), pp. 39-64, Pl. VIII, Figs. 1-16.
- (1950): Ascidiens from the Palao Islands. I, Publ. Seto Mar. Biol. Lab., I (3), pp. 115-150, Pls. IX & X, Figs. 1-23.
- TRAUSTEDT, M. P. A. (1885): Ascidae simplices fra det Stille Hav, Vidensk. Meddel. fra naturh. Foren., ann. 1884, pp. 1-60, Pls. 1-4.
- TRAUSTEDT, M. P. A. & WELTNER, W. (1894): Bericht über die von Herrn. Dr. Sander gesammelten Tunicaten, Arch. Naturgesch., Bd. 60, Pt. 1, pp. 10-14, Pl. 2.
- VAN NAME, W. G. (1902): The Ascidiens of the Bermuda Islands, Trans. Connecticut Acad. Sci., Vol. 11, pp. 325-412, Pls. 46-64.
- (1918): Ascidiens from the Philippine and Adjacent Waters, Smithson. Inst. U. S., Nat. Mus., Bull. 100, Vol. 1, Pt. 2, pp. 49-111, Pls. 23-33, Figs. 115.
- (1921): Ascidiens of the West Indian Region and Southeastern United States, Bull. American Mus. Nat. Hist., Vol. 44, pp. 283-494, Figs. 1-159.
- (1924): Ascidiens from Curaçao, Bijdr. Dierk., Afl. XXIII, pp. 23-32, Figs. 1-7.
- (1945): The North and South American Ascidiens, Bull. American Mus. Nat. Hist., Vol. 84, pp. 1-476, Pls. 1-31, Figs. 327.

SEA-STARs OF SETO AND ADJACENT WATERS*

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With Plate VIII and 8 Text-figures

The present writer (1938c) reported the sea-stars occurring in the vicinity of the Seto Marine Biological Laboratory. Recently he could further examine an additional collection of sea-stars obtained from the adjacent waters through the kindness of Dr. H. UTINOMI. One of them seems to be new to science, and three of them have not previously been recorded in Japanese waters, which are tropical forms. Here follows a list of the species newly examined by the writer. The asterisks indicate species new to Japan.

Mediaster brachiatus GOTO

Hippasteria imperialis GOTO

**Lithosoma japonica* n. sp.

**Anthenoides epixanthus* (FISHER)

**Nardoa tuberculata* GRAY

Ophidiaster cribrarius LÜTKEN

Henricia Ohshimai forma *acutispina* HAYASHI

Henricia pacifica HAYASHI

Henricia pachyderma HAYASHI

Solaster Uchidai HAYASHI

**Coronaster volsellatus* (SLADEN)

The following 37 forms of sea-stars, thus, will be noted in the vicinity of the Seto Marine Biological Laboratory.

Ord. PHANEROZONIA

Fam. Astropectinidae

1) *Astropecten scoparius* VALENCIENNES : HAYASHI ('38c)

2) *Astropecten polyacanthus* MÜLLER et TROSCHEL : HAYASHI ('38c)

3) *Astropecten kagoshimensis* DE LORIO : HAYASHI ('38c)

* Contributions from the Seto Marine Biological Laboratory, No. 181.

4) *Astropecten latespinous* MEISSNER: HAYASHI ('38c)

5) *Persephonaster setoensis* HAYASHI: HAYASHI ('38c)

Fam. Luidiidae

6) *Luidia quinararia* v. MARTENS: HAYASHI ('38c)

7) *Luidia maculata* MÜLLER et TROSCHER: HAYASHI ('38c)

Fam. Goniasteridae

8) *Mediaster brachiatus* GOTO

9) *Lithosoma japonica* n. sp.

10) *Anthenoides epixanthus* (FISHER)

11) *Hippasteria imperialis* GOTO

Fam. Oreasteridae

12) *Asterodiscus Hiroi* HAYASHI: HAYASHI ('38c)

Fam. Linckiidae

13) *Fromia indica* PERRIER: HAYASHI ('38c)

14) *Fromia monilis* PERRIER: HAYASHI ('38c)

15) *Nardoa tuberculata* GRAY

16) *Nardoa frianti* KOEHLER: HAYASHI ('38c)

17) *Certonardoa semiregularis* (MÜLLER et TROSCHER): HAYASHI ('38c)

18) *Ophidiaster lorioli* FISHER: HAYASHI ('38c)

19) *Ophidister cribrarius* LÜTKEN

20) *Leiaster grandis* HAYASHI: HAYASHI ('38c)

21) *Linckia guildingii* GRAY: HAYASHI ('38c)

Ord. SPINULOSA

Fam. Asterinidae

22) *Asterina batheri* GOTO: HAYASHI ('38c, '40)

23) *Asterina coronata* forma *japonica* HAYASHI: HAYASHI ('38c, '40)

24) *Asterina pectinifera* MÜLLER et TROSCHER: HAYASHI ('38c, '40)

Fam. Echinasteridae

25) *Henricia Ohshimai* forma *acutispina* HAYASHI: HAYASHI ('40)

26) *Henricia pacifica* HAYASHI: HAYASHI ('40)

27) *Henricia pachyderma* HAYASHI

Fam. Mithrodidae

28) *Mithrodia clavigera* (LAMARCK): HAYASHI ('38c, '40)

Fam. Solasteridae

29) *Solaster Uchidai* HAYASHI

Fam. Pterasteridae

30) *Pteraster tessellatus* IVES: HAYASHI ('38c, '40)

31) *Pteraster jordani* FISHER: HAYASHI ('40)

32) *Diplopteraster multipes* (SARS): HAYASHI ('40)

33) *Hymenaster glaucus* SLADEN: HAYASHI ('40)

Ord. FORCIPULATA

Fam. Zoroasteridae

34) *Cnemidaster wyvillii* SLADEN; HAYASHI ('43)

Fam. Asteriidae

35) *Coronaster volsellatus* (SLADEN)

36) *Coscinasterias acutispina* (STIMPSON): HAYASHI ('38c, '43)

37) *Asterias amurensis* LÜTKEN: HAYASHI ('38c, '43)

The writer must express herein his cordial thanks to Dr. H. UTINOMI, Deputy Director of the Seto Marine Biological Laboratory, for his kindness placing the specimens at the writer's disposal.

DESCRIPTIONS OF SPECIES

Mediaster brachiatus GOTO

(Pl. VIII, Figs. 3, 4)

Mediaster brachiatus: GOTO, 1914, p. 354, pl. 9, figs. 142-152; pl. 10, figs. 153-155.

Four specimens belonging to the present genus, *Mediaster*, were examined. These specimens generally agree in essential particulars with the present species. The measurements and localities are as follows:

R	r	R:r	Localities
30 mm	11 mm	2.7	Kii-oshima
46 mm	17 mm	2.7	Off Minabe, 100- 200 m in depth
52 mm	18 mm	2.9	Kii-oshima
54 mm	21 mm	2.5	Off Minabe, 100- 200 m in depth

Body nearly flattened, rays 5 in number. Interbrachial arcs wide and round. Rays gradually tapering toward the tip, rather slender. Dorsal paxillae fairly large, distinct, the large being in the radial zones, thence decreasing in size toward the side of body. A triangular area with smaller paxillae can be seen in each interrachial zone. Median radial paxillae arranged in regular series, scarcely different from the adradials in size and form. The median radial series reaches the terminal plate, both the adradials nearly the very tip of ray. The paxillae are coronal in form, the large each with 6 to 13 blunt spinelets on the periphery of tabulum and 1 to 5 in the centre. In small paxillae the central spinelets are absent, each with 4 to 6 peripheral spinelets. A

large number of the paxillae bear bivalvate pedicellariae on the edge or near the centre, 1 for a paxilla. The pedicellariae are much higher than wide and larger than the spinelets, the inner faces of the jaws slightly concaved.

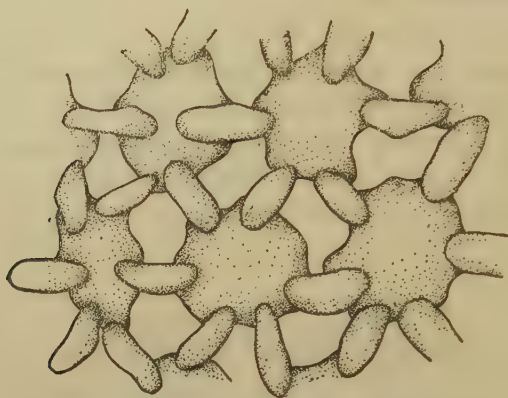


Fig. 1. *Medaster brachiatus*: Dorsal skeleton near the arm base, viewed from coelomic side, 25 $\times$.

Dorsal plates well spaced, cylindrical in form, roundish or elliptical in outline. These are each connected by small internal ossicles. Papulae one for each papular area, but rarely two. These are absent from the area adjacent to marginal plates.

Superomarginal plates distinct, confined to the side wall of body, 36-37 in number. These are higher than long in the interrarial portion of ray, then decreasing in height toward the tip of ray. The superomarginals are covered with coarse granules evenly spaced and about uniform in size. The pedicellariae on the superomarginals are not described by Goro ('14), but in the writer's specimens there are found a few bivalvate pedicellariae in the interrarial portion, mostly 1 for a plate. These are not conspicuous, but slightly larger and longer than the granules. Inferomarginal plates generally coincident with the superomarginals in size and form, forming a border to the ventral surface of body. The granulation is generally similar to that of the superomarginals, but those near the lower edge are slightly coarser. Bivalvate pedicellariae found as in the superomarginals, but not numerous.

Ventrolateral area large, and the plates are arranged regularly in series parallel to the furrow, the innermost series extending about two-thirds the length of ray. The plates are slightly convex and armed with 5 to 13 spaced granule-like spinelets somewhat pyramidal form. The ventrolaterals often bear trivalvate pedicellariae in the innermost series, the jaws being longer

and more slender than those of dorsal or marginal pedicellariae.

Adambulacral plates rather quadrate in form, each armed with 3 rows of spines. The first row consists of 7 remarkable, straight, subequal, strongly compressed, round-tipped spines, and the adoral one is slightly shorter than the others. The spines are variable in number, ranging from 5 to 8 in specimens, but mostly 6 or 7. The second row is composed of mostly 5 (4-6) spines, similar in form to those of the first row, but slightly shorter. In a number of the plates are found pedicellariae with 3 to 5 jaws. The pedicellariae are similar to the spines in appearance, taking the place of the latter, one for a plate. The third row consists of 5 (4) spines similar to those of ventrolateral plates. The adambulacral armature may be shown by the formula 6 or 7(5-8)—5(4-6)—4(3-5). Mouth plates elongated triangular in form, each with 10 to 11 stout strongly compressed furrow spines. On the ventral surface there are 7 or 8 spines along the suture line of the plates and 5 or 6 spines facing the first adambulacral plate.

Madreporite situated nearer the centre of disc than the margin.

Loc. Off Minabe, depth 100-200 m and Kii-oshima

Hippasteria imperialis GOTO

(Pl. VIII, Figs. 1, 2)

Hippasteria imperialis: GOTO, 1914, p. 338, pl. 12, figs. 178-193.

A single specimen of the genus, *Hippasteria*, was examined, which measures 43 mm in R, 24 mm in r. The example is referred to a young form of the present species, *H. imperialis*. Goto's description is based upon a single large specimen measuring 124 mm in R, 71 mm in r. which is obtained from off Misai, depth 640 m. The description of the writer's specimen is as follows:

Body stellato-pentagonal in form, flat and depressed. Interbrachial arcs fairly rounded, not nearly straight as stated by Goto ('14). Dorsal plates closely set, unequal in size, the larger ones being roundish or elliptical in form and slightly convex. The large plates are arranged in rather regular series. The primary radial and interradial plates of apical system are rather easily distinguishable from the secondary ones. These are slightly larger than the others. The small intermediate plates interpolated between the large plates have a tendency of surrounding the latter. These plates are margined with small granules. The majority of the small plates bear each a valvate, transversely elongated pedicellaria in the centre. The organ is often surrounded by coarse granules usually larger than marginal ones. The pedicellariae are

scarce in the large plates, and there is found a central group of spaced granules, which when removed leave circular pits behind them. The central granules vary in number from 1 to 13 according to the size of plates. Papulae single, situated between the plates, distributed all over the surface.

Superomarginal plates very prominent, 10 in number, with convex outer surface rounded. These in interrarial portion are coincident with the inferomarginals in position, but in the outer half of ray the two plates alternate. The superomarginals are higher than long and nearly as wide as long in interrarial portion, then become wider than long distad. The plates are each margined with a single row of closely arranged small granules, and the entire surface bears uniformly spaced coarse granules. There are, besides, large valvate pedicellariae along the lateral surface of the plates, 1 or 2 for a plate, but the organ is absent from the distal 3 or 4 plates. The pedicellariae are similar in form to those of dorsal plates. Inferomarginal plates closely similar to the superomarginals in all respects.

Ventrolateral plates closely set to one another, mostly subpentagonal in form. These are arranged in fairly regular longitudinal series, though being a little irregular in the portion adjacent to mouth plates, where small secondary intermediate plates are placed between them. Almost all the plates are each armed with a large valvate pedicellaria. The organ is encircled by 10 or more granules various in size. Those 3 or 4 facing the outer face of valve are much enlarged and compressed. A few additional smaller granules are placed at the outer side of the large granules, but most of the plates lack the secondary granules. The pedicellariae are usually single in Goro's description, but in the present specimen 2 pedicellariae occur in the plates adjacent to adambulacral plates. When 2 pedicellariae present, one of them is much smaller, about half as large as the other.

Adambulacral plates wider than long in the proximal portion of ray, squarish in the distal half. The armature is composed of 2 or 3 stout, flattened, bluntly pointed furrow spines. When 3 spines present, the adoral one is smaller and shorter than the others. Behind the furrow series stands a stouter but shorter subambulacral spine. When there are 2 spines, the adoral one is much smaller. Next follows a row of 2 large conico-elliptical spines or granules. Besides these, 3 or 4 small granules are placed along the transverse margin of the plate, and those on the outer margin are scarce. The armature of mouth plates consists of a series of stout, long, compressed 5 or 6 furrow spines. The one at the mouth end is thicker and longer than the others, the remainder rather regularly graduated, and the outermost much smaller. On the surface of the plate are 2 suboral spines parallel to the furrow series. On the rest of the surface are several granules various in size.

Madreporite circular in form, slightly smaller than the large dorsal plates, situated nearer the centre of disc than the margin.

Loc. Kii-oshima, depth unknown.

Lithosoma japonica sp. nov.

(Pl. VIII, Figs. 6, 7, 8, 9)

The writer examined two specimens belonging to Goniasteridae. The specimens agree with *Lithosoma*, a deep-sea form of the Philippine Islands, in general respects, though rays are not long and slender, but short, and small spatulate excavate pedicellariae absent from dorsal surface. The Japanese specimens may be referred to a new form of *Lithosoma*. The measurements are as follows:

R	r	R:r
33 mm	17 mm	1.9
24 mm	12 mm	2.0

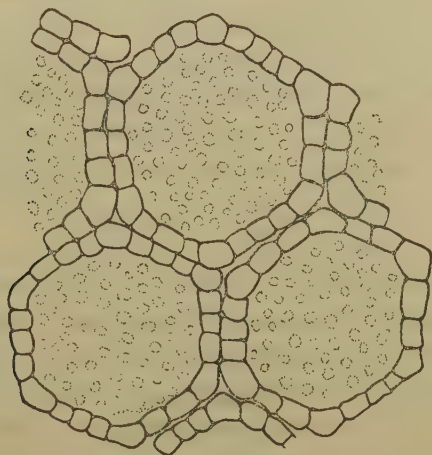


Fig. 2. *Lithosoma japonica*: Dorsal plates in the radial portion, 25 $\times$.

Breadth of ray at base in the large specimen measures 20 mm, at 3rd superomarginal plates 12 mm.

Dorsal area stellato-pentagonal. Dorsal plates hexagonal in form, arranged in regular radial and parallel series, the surface being smooth, bearing numerous uniformly spaced minute blister-like bosses. Those of the mid radial

series are very slightly larger than the neighbours, but never conspicuously. All the plates are bordered by a single complete series of flat immersed granules squarish or oblong in form. No secondary smaller intermediate plates. Papulae 6 about a plate, 1 for each corner of plate, but absent in interradiar areas. No pedicellariae in dorsal plates. When viewed from coelomic side, the dorsal plates are hexagonal with somewhat truncated corners and the surface convex. In interradiar areas lacking papulae the plates fit tightly together.

Marginal plates massive, wider than long, and the surface swollen. Supermarginal plates 9 in number, and beyond the 4th these are in contact with each other alternately along radial median line. The first plates are slightly smaller than the following 3 or 4, the 3rd or 4th being most massive, then gradually decreasing in size toward the tip of ray. The surface of the plates is smooth, but numerous minute hyaline bosses are scattered uniformly on the dorsal side. These are more spaced and inconspicuous than those on the dorsal plates, and become gradually indistinct toward the lateral side of plate. Marginal granules small, mostly oblong. Tiny 2-jawed entrenched spatulate pedicellariae, if present, occur along the transverse margin of the plate or the outer margin, 1 or 2 for a plate. The base of each jaw is about half as wide as the length. Inferomarginal plates correspond to the superomarginals in position, the first plates being smaller than the following 2 or 3 as in the superomarginals. No hyaline bosses on the surface. In the smaller specimen at the writer's hand the hyaline bosses are absent from the surface of the marginals, the occurrence of the bosses, therefore, seems to be an unreliable feature to classify the present group, especially in unmatured specimens.

Ventrolateral plates slightly swollen, with minute hyaline bosses on the surface, arranged in relatively regular chevrons. These are regular or less regular 4-sided, and the series next to adambulacral plates extending beyond the middle of R. Small entrenched pedicellariae occur in the series, mostly 1 for a plate, rarely 2. The marginal granules are more distinct than in marginal plates.

Adambulacral plates each with an angular furrow face deep in furrow, the aboral facet of the apophysis being concave and longer than the adoral which is slightly concave or nearly straight. The first 3 or 4 plates each with a shallow angle. The apophysis is more angular in the smaller specimen, separating the consecutive pairs of tube-feet. Furrow comb consisting of proximally 5 or 6, further along ray 7 to 9 subequal robust spines, the mesials being prismatic or flattened with edge to furrow. The most aboral ones are

much thicker and broader than the mesials, with side to furrow, about twice as wide as the latter.

In the smaller specimen the furrow comb consists of 5 or 6 blunt, more or less compressed spines, the distalmost being the broadest. There is a distinct interval without spines on the aboral facet of the apophysis, and the enlarged spine is separated from the rest.

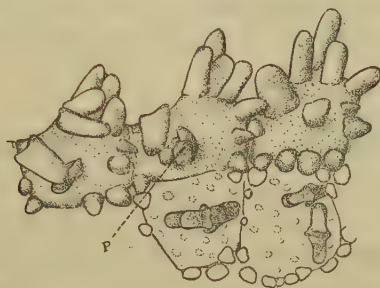


Fig. 3. *Lithosoma japonica*: Adambulacral plates and the ventrolaterals in the specimen (R 24 mm), the right ones being the 6th, 15X; p. pedicellaria with 4 valves.

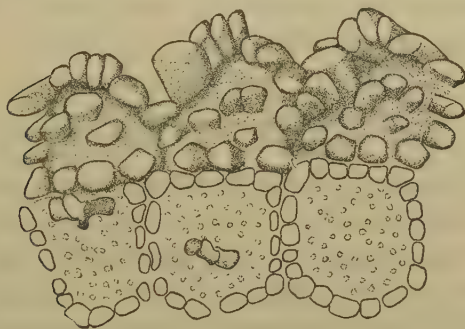


Fig. 4. *Lithosoma japonica*: Adambulacral plates and the ventrolaterals in the specimen (R 33 mm), the right ones being the 5th, 15X.

The border of plates is beset with a row of 6 to 8 subequal subconical granules, and the surface with 2 to 5 granules forming more or less a longitudinal series spaced from the furrow comb. In the smaller specimen the marginal granules are fewer, and the granules on the surface are mostly replaced by a pedicellaria with 2 to 5 broad jaws.

Mouth plates small, rather evenly triangular, the straight furrow margin bearing 6 or 7 spines. The innermost spine is enlarged, heavy, four-sided, the rest compressed, prismatic, round-tipped, and the outermost one flattened, a little enlarged. Seven or 8 suboral granules situated along the median suture

line, and the inners prismatic or four-sided. Between the series and the furrow are 3 to 5 granules.

Madreporite small, flat, hexagonal surrounded by 6 plates, with coarse irregular ridges radiating from the centre, situated about one-third the distance from the centre of disc to the margin. In the smaller specimen the madreporite is surrounded by 5 plates.

Loc. Kii-oshima, depth unknown.

Anthenoides epixanthus (FISHER)

(Pl. VIII, Figs. 10, 11)

Antheniaster epixanthus: FISHER, 1906, p. 1037, pl. 20, fig. 3; pl. 26, figs. 1, 1a-c; pl. 29, figs. 1, 2; pl. 49, fig. 1.

The present species has previously been reported only from the Hawaiian Islands, from 178 to 267 fathoms in depth. The writer examined 2 specimens closely related to the species. They are probably a young, *slender-rayed* form of the species, though differing from which in having thin membrane. The measurements are as follows:

R	r	R:r
42 mm	17 mm	2.5
36 mm	14 mm	2.6

Body flat and depressed. Disc large, pentagonal in form, slightly inflated. Rays tapering, short and slender. Interbrachial arcs rounded. The dorsal surface is overlaid by an exceedingly thin membrane, which in drying allows microscopic granules to be seen. The granules are subequal in size, scattered all over the surface, but closely placed in interradian areas, where these are uniformly scattered, 30 or more for a plate.

Dorsal plates hexagonal in form, arranged in regular series, the radials being wider than long. Intermediate plates poorly developed in either side of the radial median. Papulae confined to radial regions, 1 for each corner of plate. No pedicellariae in dorsal surface.

Superomarginal plates 15 in number, opposite to each inferomarginal plate in position, gradually decreasing in width toward the tip of ray. About 5 proximal plates have spaced coarse granules in the centre and microscopic granules surrounding them. The coarse granules are 9 or 10 in number in the first plate, 4 or 3 in the 4th, and these are absent from the outer half of ray. Terminal plates pentagonal in form, longer than wide, with 5 spinelets, 3 of which being a little prominent. Inferomarginal plates wider than long, de-

creasing regularly in size distad and more massive than the superomarginals. The granulation of these plates is similar to that of the superomarginals but the granules are slightly coarser than the latter. The coarse granules are found along the edge of ray, but absent from the outer half.

Ventrolateral plates slightly tumid, arranged in chevrons, decreasing in size toward the margin of disc, each with 1 to 7 unequal, spaced large sub-hemispherical granules surrounded by 8 to 18 spaced small granules. Some of them adjacent to mouth plates bear 2-jawed pedicellariae, 1 for a plate. The jaws rarely 3.

Adambulacral plates longer than wide, with slightly curved furrow margin, each bearing a comb of 6 or 7 a little divergent, slender, slightly compressed, bluntly pointed furrow spines webbed for half their length. The mesial spines are longer than the laterals. Along middle of plate are a small bluntly pointed, subconical spine and 2 or 3 coarse granules. The spines are heavier but shorter than the furrow spines and gradually become long and stout toward the distal portion of ray. Between both the series, near the adoral margin of plate stands a rather slender 2-jawed, narrowly spatulated pedicellaria. The pedicellariae occur in the first 1 or 2 plates and absent in the remainder.

Mouth plates slightly convex, each with 8 or 9 oral spines, the inner 3 or 4 being enlarged and strongly compressed. Suboral armature composed of 3 or 4 short suboral spines and small spaced granules and in addition to these a pedicellaria, if present.

Madreporite flat, subcircular in form, situated a little nearer the centre of disc than the margin.

Gonads arranged in a compact series on either side of and parallel to interbranchial septum.

Loc. Off Minabe, depth 100 m and Oshima, depth unknown.

Nardoa tuberculata GRAY

Nardoa tuberculata: FISHER, 1919, p. 384, pl. 110, fig. 1; HAYASHI, 1938, p. 430, pl. 3, figs. 1, 2.

The tropical sea-star has not previously been recorded from Japan. A single specimen of the present species was examined, measuring 40 mm in R, 10 mm in r. It seems to be a young form. The young form of *N. tuberculata* is very difficult to distinguish from *N. tuberculata* forma *obtusa* in the Ryukyu Islands, but the specimen examined has gradually tapering rays, thus the identification.

Loc. Kii-oshima.

Ophidiaster cribrarius LÜTKEN

Ophidiaster cribrarius: HAYASHI, 1938, p. 64, pl. 4, figs. 7-13.

The present species has previously been recorded from the Ogasawara Islands and Amakusa, Kyusyu in Japan. A single 2-rayed specimen was examined, measuring 16 mm to 53 mm in R, 7 mm in r. The rays are various in length, the two being short.

Loc. Kii-oshima.

Henricia Ohshimai forma *acutispina* HAYASHI

Henricia Ohshimai forma *acutispina*: HAYASHI, 1940, p. 158, pl. 10, figs. 5, 6.

A single specimen of *Henricia* was examined, measuring 35 mm in R, 8 mm in r. It seems to be a form of the present species recorded by the present writer ('40) from Kii Channel, depth 200 m and off Rebun Is., depth 142 fathoms.

Second ventrolateral series present, reaching about half the length of ray, each with 2 to 5 spinelets. Adambulacral armature composed of 5 to 7 long slender spines, and furrow spines single.

Loc. Kii-oshima, depth 300 m.

Henricia pacifica HAYASHI

Henricia pacifica: HAYASHI, 1940, p. 152, pl. 9, figs. 7-10.

A single specimen of slender-rayed *Henricia* was examined. It measures 40 mm in R, 7 mm in r. The example is referable to the present species collected by Soyo-maru from off Goto Is., off Seto and Tsugaru Strait, depth 200 m.

Loc. Kii-oshima, depth 300 m.

Henricia pachyderma HAYASHI

Henricia pachyderma: HAYASHI, 1950, p. 160, pl. 7, figs. 1, 2.

Five specimens of *Henricia* were examined, which are considerably in unfavourable condition. Judging from the skeletal structure, these specimens seemingly belong to the present species. The measurements are as follows:

R	r	R	r
36 mm	8 mm	42 mm	10 mm
40 mm	10 mm	43 mm	10 mm
40 mm	9 mm		

Loc. Off Minabe, depth 100-200 m.

Solaster Uchidai HAYASHI

Solaster Uchidai: HAYASHI, 1939, p. 306, pl. 24, figs. 3, 4; HAYASHI, 1940, p. 184.

A single specimen of *Solaster* was examined, measuring 80 mm in R, 33 mm in r, rays 11 in number. It is a typical form of the present species distributing in the north Pacific coast of Honsyu, Japan.

Loc. Probably Kii-oshima.

Coronaster volsellatus (SLADEN)

(Pl. VIII, Figs. 12, 13, 14)

Asterias (Stolasterias) volsellata: SLADEN, 1889, p. 584, pl. 107, figs. 1-4.

Heterasterias volsellata: VERRILL, 1914, pp. 27, 47.

Coronaster volsellatus: FISHER, 1917, p. 25; FISHER, 1919, p. 496, pl. 135, figs. 4, 4a; pl. 151, figs. 2, 2a-c.

The present sea-star has not previously been recorded from the Japanese waters, but only from the Philippine Is. The specimens examined are

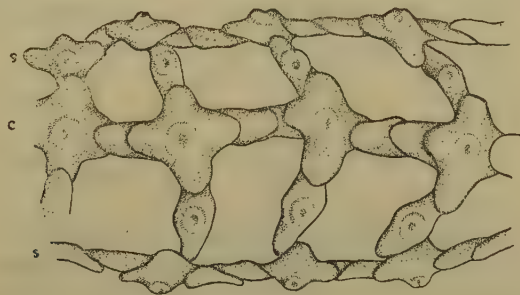


Fig. 5. *Coronaster volsellatus*: Skeletal structure in the proximal portion of ray, 5×; c carinal series, s supero-marginal series.

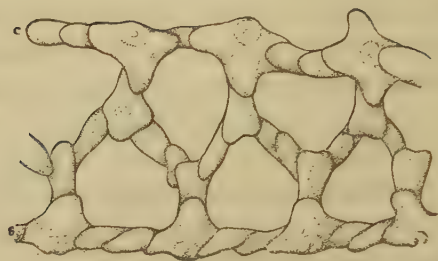


Fig. 6. *Coronaster volsellatus*: Skeletal structure in the proximal portion of ray, 5 $\times$; c carinal series, a superomarginal series.

certainly referable to the present species. Four specimens were examined. In the two, all the rays are separated from disc. In the other two, some of the rays are disjointed. The joint of rays to disc may be fragile. One of them measures 56 to 82 mm in R, 7.5 mm in r, the other 69 to 70 mm in R, 7 mm in r. R ranging from 10 r to 11 r.

Disc small, circular, the dorsal surface being nearly flat. Rays long and slender, 10 to 11 in number, more or less narrowed near the base.

Dorsal integument thin. Dorsal skeleton widely meshed, the mesh being more or less irregular, squarish or subpentagonal in form. Carinal plates arranged in a regular longitudinal series, composed of cruciform principal plates at each skeletal node and oblong connective ones, generally 1 or 2 in each interval. Carinal spines slender and acute, 1 for each principal plate, 3-3.6 mm in length. Dorsolateral skeleton composed of elongated plates interpolated between carinal plates and the superomarginals, 1 for each interval. The dorsolateral papular areas, therefore, are more or less quadrate in form. The skeletons, however, often form a mesh, and the papular areas are subpentagonal in form. Dorsolateral spines similar to the carinals in size and form, but slightly more slender. The spines are 2.7-3.7 mm long.



Fig. 7. *Coronaster volsellatus*: Skeletal structure in the proximal portion of ray, 5 $\times$; i inferomarginal series, s superomarginal series.

Superomarginal plates cruciform, the lower lobes overlapping to each inferomarginal plate. The superomarginals are each joined by oblong intermediate plate, generally 2 in each interval. Inferomarginal plates corresponding to the superomarginals in position, each connected by 2 or 3 intermediate oblong plates. Intermarginal papular areas large, rectangular in form. Marginal spines slender and acute, one for each principal plate. Inferomarginal spines slightly longer than the superomarginals, measuring 3.6–4.1 mm in length at the proximal portion of ray.

Dorsal and marginal spines thickly encircled by a large number of small crossed pedicellariae born upon a heavy sheath. The crossed pedicellariae in dorsal spines measure 0.26 to 0.3 mm in length, and those of marginal spines are slightly smaller, 0.2 to 0.27 mm in length. Each lateral tooth of the jaws is enlarged, but the one a little smaller than the other. Small straight pedicellariae scattered all over the surface, measuring about 0.46 to 0.56 mm in

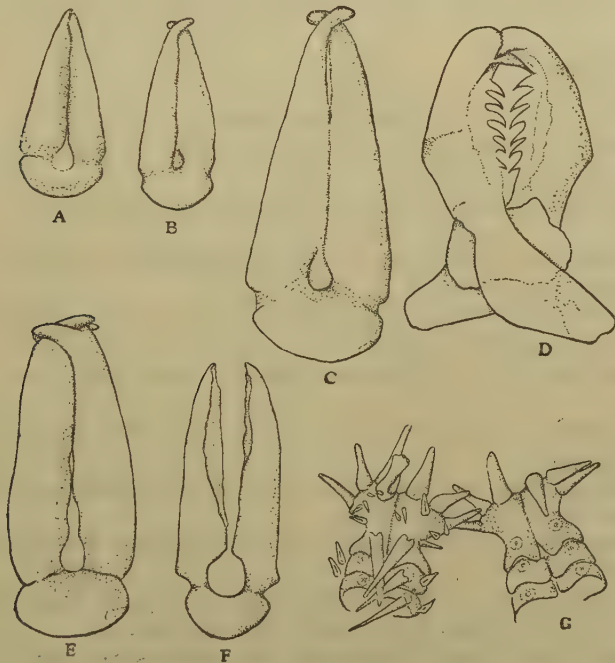


Fig. 8. *Coronaster volsellatus*: (A) straight pedicellaria in furrow, 85 $\times$; (B) straight pedicellaria in furrow, 85 $\times$; (C) straight pedicellaria in furrow, 65 $\times$; (D) dorsal crossed pedicellaria, 140 $\times$; (E) large straight pedicellaria in mouth plate, 35 $\times$; (F) straight pedicellaria in dorsal papular area, 65 $\times$; (G) ventral view of mouth plates and adambulacral plates, 5 $\times$.

length. Large unguiculate pedicellariae found in the mouth plates, 1 or 2 for a plate. The large ones are about 1.2 mm long.

Adambulacral plates small, band-like, separated by an interval being slightly wider than the length. Adambulacral spines single, arranged in a series, about 1.7 to 2.0 mm long in the proximal portion of ray. The spines are slender and tapering, without attached pedicellariae. Along furrow are scattered small pedunculate straight pedicellariae. These are various in size, about 0.25 to 0.8 mm in length, and the jaw-tips of the large ones are slightly crossed. Mouth plates large, excavated for the first tube-feet. On the middle of the ventral surface stands a stout cylindrical suboral spine, about 2 mm long, the base being more or less compressed. Oral spines 2 (3) for a plate, the inner one being similar to suboral spine in size and form, but the base more compressed. The outer ones are smaller than the inner, about half as large as the latter. There are no conspicuous streamers of straight pedicellariae at the base of spines.

Madreporite circular in form, situated nearer the margin of disc than the centre.

Loc. Kii-oshima.

LITERATURE CITED

- FISHER, W. K. 1906. The Starfishes of the Hawaiian Islands. U. S. Fish. Commission Bulletin for 1903, pt. iii, p. 987-1130, 49 pls.
- 1917. The Asteroid Genus *Coronaster*. Proc. Biol. Soc. Washington, vol. 30, pp. 23-26.
- 1919. Starfishes of the Philippine Seas and Adjacent Waters. Smiths. Inst. U.S. Nat. Mus., Bull. 100, vol. 3, 712 pp. 156 pls.
- GOTO, S. 1914. A Descriptive Monograph of Japanese Asteroidea. J. Coll. Sci. Imp. Univ. Tokyo, vol. 29, art. 1, pp. 1-808, 19 pls.
- HAYASHI, R. 1938a. Sea-stars of the Ogasawara Islands. Annot. Zool. Japon., vol. 17, pp. 59-68, 1 pl.
- 1938b. Sea-stars of the Caroline Islands. Palao Trop. Biol. Station Studies, vol. 1, no. 3, pp. 417-446, 3 pls.
- 1938c. Sea-stars in the Vicinity of the Seto Marine Biological Laboratory. Bull. Biogeogr. Soc. Jap., vol. 8, pp. 271-292, 3 pls.
- 1939. Solasterids in Japanese Waters. J. Fac. Sci. Hokkaido Imp. Univ., ser. 6, Zool., vol. 6, pp. 297-311, 2 pls.
- 1940. Contributions to the Classification of the Sea-stars of Japan, I. Spinulosa. J. Fac. Sci. Hokkaido Imp. Univ., ser. 6, Zool., vol. 7, pp. 107-204, 7 pls.
- 1943. Contributions to the Classification of the Sea-stars of Japan, II. Forcipulata, with the Note on the Relationship between the Skeletal Structure and Respiratory Organs of the Sea-stars. Ibid., vol. 8, pp. 133-281, 11 pls.
- SLADEN, W. P. 1889. Report on the Asteroidea collected by the H. M. S. Challenger. Zoology, vol. 30, xlii+893 pp., 117 pls., 1 chart.
- VERRILL, A. E. 1914. Monograph of the Shallow-water Starfishes of the North Pacific Coast from the Arctic Ocean to California. Smiths. Inst. Harriman Alaska series, vol. 14, 2 parts, xii+408 pp., 110 pls.

EXPLANATION OF PLATE VIII

- Fig. 1. *Hippasteria imperialis*; dorsal side. About $2/3\times$.
Fig. 2. *Hippasteria imperialis*; ventral side. About $2/3\times$.
Fig. 3. *Mediaster brachiatus*; dorsal side. About $4/5\times$.
Fig. 4. *Mediaster brachiatus*; ventral side. About natural size.
Fig. 5. *Nardoa tuberculata*; dorsal side. About $2/3\times$.
Fig. 6. *Lithosoma japonica* n. sp.; ventral side. About $3/4\times$.
Fig. 7. *Lithosoma japonica* n. sp.; dorsal side. About $3/4\times$.
Fig. 8. *Lithosoma japonica* n. sp.; ventral side. About $3/4\times$.
Fig. 9. *Lithosoma japonica* n. sp.; dorsal side. About $3/4\times$.
Fig. 10. *Anthenoides epixanthus*; dorsal side. About $2/3\times$.
Fig. 11. *Anthenoides epixanthus*; ventral side. About $2/3\times$.
Fig. 12. *Coronaster volsellatus*; dorsal side. About natural size.
Fig. 13. *Coronaster volsellatus*; ventral side. About $2/3\times$.
Fig. 14. *Coronaster volsellatus*; ventral side. About $2/3\times$.



R. HAYASHI: SEA-STARS OF SETO AND ADJACENT WATERS.

DENDRONEPHTHYA OF JAPAN, I.

DENDRONEPHTHYA COLLECTED CHIEFLY ALONG THE COAST OF KII PENINSULA*

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With Plates IX—XI and 29-Text-figures

The spicular coral *Dendronephthya* (together with *Stereonephthya*), formerly known as *Spongodes* before the time of KÜKENTHAL (1905), contains an enormous number of species, not fewer than 150 species, and is widely distributed in the warmer waters of the Indo-Pacific region, ranging from the Red Sea to Japan. An only exception is *D. mexicana* from the west coast of Mexico.

Up to this time the Japanese species of *Dendronephthya* have been studied by many authors, such as STIMPSON, VERRILL, GRAY, STUDER, HOLM, PÜTTER, MAY, KÜKENTHAL and NUTTING. Of these authors, VERRILL (1864, 1865) for the first time described 3 new species, one of which was from Ryukyu and two from Hongkong, based on STIMPSON's collection. Next STUDER (1888) recorded 6 new species based on DÖDERLEIN's collection, and HOLM (1895) recorded 8 new species based on SUENSON's collection. PÜTTER (1900) recorded 2 species as "von Ostasiatische Küste", together with 4 new species from China Sea, from SALMIN's collection, and MAY (1900) also one new species from HILGENDORF's collection.

KÜKENTHAL (1905), in his revision of the family Nephthyidae, enumerated and described in detail all the known species in the world; in this he summed up about 20 species including 7 new species from Japanese waters. In the next year (1906) he described 9 known and 6 new species based on DOFLEIN's and HABERER's vast collections. He (1911) later added one known species to the faunal list of Japan. Lastly NUTTING (1923) recorded 2 known and 3 new species from the "Albatross" collection.

Summing up all existing records, there are no less than 33 species described from Japan, as belonging to this genus.

* Contributions from the Seto Marine Biological Laboratory, No. 182.

To these many species of *Dendronephthya* I here add thirteen which are to be described as new species (marked by ** in the appended table). And also of fifteen already described species, six are newly added to the fauna of Japan (marked by * in the table).¹⁾ The materials on which the descriptions of these species are based have been collected chiefly from shallow waters around the coast of Kii Peninsula, middle Japan. In addition to these materials from Japan, a description of a new species from Palao is included in this paper. Types of these new species, as well as other described species, are deposited in the zoological collections of the Seto Marine Biological Laboratory.

Such an enormous addition is not so surprising, since the previous collections of Japanese Alcyonarians which have been made by foreigners and by expeditions are mostly confined to rather deep-water forms, mostly in depths more than 20 fathoms, and therefore lacking in reef forms. As far as I have experienced, *Dendronephthya* (*Stereonephthya* also) seems to be very luxuriant along the Pacific coast of southern Japan, probably more than in tropical seas, and may be easily observed alive on the shore. All the material to be described here are those obtained by shore collecting or by dredging in shallower waters than 30 meters in depth, unless otherwise particularly mentioned.

The difficulty of taxonomy of *Dendronephthya* lies in the enormous number of species of the group which differ from one another only in very minute characters. KÜKENTHAL (1905), in his excellent work of revision, arranged it in three main divisions: (1) Glomeratae, (2) Divaricatae and (3) Umbellatae, based on the growth form of the colony. He then splitted these groups into many minor sections with different modes of branching. SHERRIFFS (1922), based on the examination of this group of the "Siboga" collection, proposed the useful system of "anthocodial grade and formula" according to the differences of the anthocodial armature which example was followed by THOMSON and DEAN (1931) and ROXAS (1933).

Both systems are very useful in the taxonomy of this group, but not yet sufficient to raise these groups to the status of distinct subgenera or even genera. Therefore, the present system of classification is still of a relatively

1) After this report was written, the following 5 species which were collected by Mr. T. YAMAMOTO at Kusimoto have been newly added to my collection:

D. suenisoni (HOLM)—Divaricatae.

D. gracillima KÜKENTHAL—Divaricatae.

D. sp. nov. A—Divaricatae.

D. sp. nov. B—Divaricatae.

D. cf. flabellifera (STUDER)—Umbellatae.

The description of these species will be given in another paper.

trivial sort. But in doing so and thereby adopting the combined classification of KÜKENTHAL'S and SHERRIFFS' systems, I must confess that KÜKENTHAL'S system is more useful to arrange a number of species into major groups by mere superficial examination than SHERRIFFS' system. However, KÜKENTHAL'S system may afford further confusion in the systematic arrangement from the phylogenetic point of view, if laying much stress on the evolution of anthocodial armature alone, as done by SHERRIFFS. The problem as to the evolution of species is thus still unsettled.

The classification followed herein is that of KÜKENTHAL (1905), with some modification of SHERRIFFS' anthocodial formula, in which I am using, in addition, the pairs of intermediate spicules abbreviated as "M"; in this case if intermediate spicules are unpaired, it is given as " $\frac{1}{2}$ M". All other grades are followed SHERRIFFS. To simplify the descriptions of species I use herein the abbreviated term "S.B." for the supporting bundle or "Stützbündel" in texts as in the anthocodial formula.

In pursuing this study I am greatly indebted to my revered teacher, Emer. Prof. Taku KOMAI for his kind suggestion and constant encouragement. Thanks are also due to Messrs. T. YAMANOUCHI, T. YAMAMOTO, M. OZAKI, S. SAKAGUCHI, S. URA and Y. SAIKA for assistance in collecting the material. The work was aided by a grant from the Scientific Research Expenditure of the Ministry of Education.

TABLE OF THE SPECIES EXAMINED

	Species	Anthocodial grade (after SHERRIFFS)	Growth form (after KÜKENTHAL)	New record in Japan
I. GLOMERATAE.				
1	<i>D. nipponica</i> n. sp.	II	<i>hemprichi</i> group	**
2	<i>D. tuberculata</i> n. sp.	II	, ,	**
3	<i>D. gigantea</i> (VERR.)	III	, ,	
4	<i>D. aurea</i> n. sp.	III	, ,	**
5	<i>D. aculeata</i> KÜKTH.	IV	, ,	
6	<i>D. spinifera</i> (HOLM)	IV	<i>stuederi</i> group	*
II. DIVARICATAE.				
7	<i>D. japonica</i> KÜKTH.	II	<i>swensoni</i> group	
8	<i>D. palmata</i> n. sp.	II	<i>rigida</i> group	**
9	<i>D. furcata</i> n. sp.	III	, ,	**
10	<i>D. alba</i> n. sp.	IV	<i>cervicornis</i> group	**
11	<i>D. palaoensis</i> n. sp.	IV	<i>rigida</i> group	(**)

12	<i>D. filigrana</i> KÜKTH.	IV	<i>rigida</i> group	
13	<i>D. divaricata</i> (GRAY)	IV	<i>divaricata</i> group	*
14	<i>D. gol'go'ha</i> n. sp.	VI	<i>suensoni</i> group	**
15	<i>D. cervicornis</i> (WR. & STUD.)	VI	<i>cervicornis</i> group	*
16	<i>D. decussatospinosa</i> n. sp.	VI	<i>rigida</i> group	**
III. UMBELLATAE.				
17	<i>D. dromidicola</i> n. sp.	I	<i>collaris</i> group	**
18	<i>D. spinulosa</i> (GRAY)	II	<i>spinulosa</i> group	*
19	<i>D. pellucida</i> n. sp.	II	<i>dendrophyta</i> group	**
20	<i>D. habereri</i> KÜKTH.	III	<i>disciformis</i> group	
21	<i>D. dofleini</i> KÜKTH.	III	<i>florida</i> group	*
22	<i>D. pulchella</i> n. sp.	III	<i>spinulosa</i> group	**
23	<i>D. disciformis</i> KÜKTH.	IV	<i>disciformis</i> group	*
24	<i>D. densa</i> KÜKTH.	IV	<i>spinosa</i> group	
25	<i>D. acaulis</i> KÜKTH.	IV		
26	<i>D. castanea</i> n. sp.	IV	?	**
27	<i>D. pectinata</i> (HOLM)	IV	<i>pectinata</i> group	
28	<i>D. longicaulis</i> KÜKTH.	VI	<i>collaris</i> group	
29	<i>D. gloriosa</i> n. sp.	VI	<i>spinulosa</i> group	**

I. GLOMERATAE

1. *Dendronephthya nipponica* n. sp.

(Fig. 1; Plate IX, Figs. 1, 2)

D. spec. aff. hemprichi, KÜKENTHAL (1906, p. 38).

Glomerate. Colony rigid, low and bushy, with encrusting flat base. From a short, robust, cylindrical stalk arise erect one or more main branches, that in turn give off some secondary branches roundly ended. Base of lowest branches foliaceous to form a complete collar around stem. Total height very variable ranging from 3.5 cm to 17 cm, of which about one-fourth or one-fifth belongs to sterile stalk.

Polyps in compact groups of 5 to 12 on main branches and twigs. Polyp head rounded flat cuplike, about 0.35–0.45 mm high and 0.7–0.8 mm wide, standing at an obtuse angle with very short and plump stalk, usually shorter than 0.5 mm; ventral side of polyp stalk below head usually with very few rodlike small spicules or nude. Anthocodial armature in eight double rows of 5–7 converging pairs; uppermost one or two of points a little longer than the rest, up to 0.3 mm in length, usually incurved but not far extended upright. No crown spicules present. S. B. strongly developed, of which 1 or 2 large spicules

up to 2.6 mm long and 0.24 mm wide, densely spinose throughout, except at extremities only and project for about 0.5 mm long beyond polyp head. Tentacle spicules opaque, red, oval to elongate, up to 0.035 mm long and sparsely set in two rows. Anthocodial formula:

$$II = (5-7) p + 0 Cr + \text{strong S.B.} + (0-3) M$$



Fig. 1. *Dendronephthya nipponica* n. sp. a, b, Polyp; c, spindle from upper cortex; d, stellate spicules from lower cortex; e, warty spindle and quadriradiate from canal-walls; f, flat spicules from canal-walls. (All $\times 35$)

On cortex of branches and twigs are white spindles covered with close-set rounded warts, up to 3 mm long, lying transversely. On lower cortex are mostly smaller stellate or irregular-shaped forms of various dimensions, together with short, curved, plump spindles with tuberculate warts, relatively fewer in number. Canal-walls sparsely filled with colorless, robust spindles, triradiates or quadriradiates with rounded warts up to 1.5×0.18 mm. In addition there are tiny flat rods, triradiates and quadriradiates with a few low warts.

Coloring. Polyp spicules blood-red or purple, but polyps themselves yellowish white. Branch and stalk greyish white, often tinged with red at base.

Locality. Very common around Kii coast, from shore to 100 m depth. Probably widely distributed along the Pacific coast of Japan as far north as Sagami Bay.

Remarks. KÜENTHAL (1906) suggests a close affinity of this form from Sagami Bay with *D. hemprichi* (KLUNZINGER) which is known to occur in Red Sea and East African coast. He gave no account, however, for the specific

differences between the Japanese and Red Sea forms. I have had no opportunity to examine the Red Sea specimens of *D. hemprichi*, but from the detailed descriptions of the latter in comparison with allied forms given by THOMSON and McQUEEN (1908), there seems to be no doubt about the distinctness of the Japanese species from that of Red Sea. Distributional gap may warrant this view, no specimen referred to *D. hemprichi* having ever been recorded from the Indian, Malayan and Philippine regions.

2. *Dendronephthya tuberculata* n. sp.

(Fig. 2; Plate IX, Fig. 5)

Glomerate. Colony very compact and stout, having a superficial resemblance to *D. gigantea*. From a short, broadly expanded base arises a columnar, stout, erect stem which gives off about eight short main branches wholly covered with a number of short polyp-bearing twigs of approximately equal length, less than 5 mm. Lowest branches slightly foliaceous, completely encircling stem at base of polyparium. In one of four specimens examined, polyparium is 8 cm by 7 cm and sterile stalk 2-3 cm in height; in the other one, polyparium 4 cm high and sterile stalk 1-2 cm high. In young form attached to base of a larger colony, its total height is about 3.5 cm. and polyparium and stalk are almost similar in length.

Polyps in compact groups of 10 to 20 at ends of twigs. Polyp head about 0.6 mm long and 0.7 mm wide, standing at an obtuse angle with short, stout polyp stalk, at most 0.6-0.8 mm long and 0.58 mm wide at base. S.B. of the entheathing type, consists of about 6 large plump spindles up to 2 mm long and numerous smaller accessory ones, about 0.5-1.2 mm long; they are all very tuberculate throughout and bluntly ended, uppermost larger ones slightly project beyond polyp head. Polyp armature composed of eight double rows of compactly disposed, orange-colored, tuberculate spindles similar to S.B. spicules, giving the polyp a pebbly ornamentation. Uppermost points often broadly tipped in a club-like shape. Point spicules on lateral sides 6-8 in a row, approximately similar in size, usually 0.3 mm long and 0.035 mm wide; they become smaller and fewer towards ventral side, where they are often 5-6 in a row. 2-4 small, less-tuberculate intermediate spicules occur at the lowest angle between points. Tentacles very long, about 0.52 mm long, with many long slender pinnules and with a few orange-colored, minute rodlike spicules, about 0.05 mm long, irregularly disposed but converging downwards. Ventral side of polyp stalk provided with a few orangish, somewhat flat, less-tuberculate

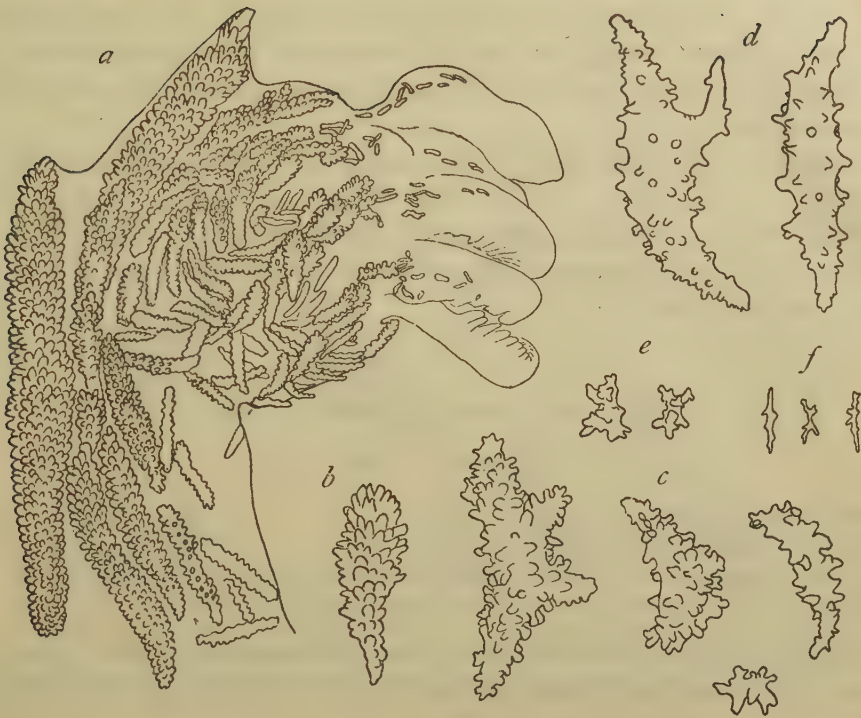


Fig. 2. *Dendronephthya tuberculata* n. sp. a, Polyp; b, club-shaped uppermost point spicule; c, spicules from lower cortex; d, large spicules from canal-walls; e, small stars from canal-walls; f, minute flat rods from canal-walls. (b×80, all the others×55)

spindles between highly tuberculate, yellowish accessory spicules of S.B. Anthocodial formula:

$$\text{II} = (6-8) \text{ p} + 0 \text{ Cr} + \text{strong S.B.} + (1-2) \text{ M}$$

On cortex of stem and branches are transversely arranged, white or yellowish, spindles with close-set, prominent rounded warts, up to 3 mm long. On lower cortex, in addition to superficially disposed larger spindles similar to those of upper cortex, there occur shorter, curved spindles which pass to pseudo-clubs, almost globular stellate forms, mostly 0.35-0.53 mm long and rarely much smaller stars, about 0.17-0.25 mm long. Canal-walls thickly filled with three kinds of colorless spicules as follows:

(a) Large spindles or triradiates with few conical or truncated warts; 0.4×0.07 mm, 0.53×0.05 mm, 0.85×0.11 mm.

(b) Small stars, similar to those of basal cortex; mostly 0.17-0.25 mm long.

(c) Minute, slightly toothed, elongate flat rod; mostly 0.05-0.12 mm long.

Coloring. On the whole rusty or orange in color. Examination with a lens shows, however, that polyps are reddish orange, S.B. orangish yellow, and branch and stalk greyish yellow mottled with white, depending on the coloration of spicules.

Localities. Kii-ôshima. 1940. S. SAKAGUCHI *leg.*; (paratype) Minabe. 1952. M. OZAKI *leg.*

Remarks. This form is closely allied to *D. gigantea* and *D. aurea* in its color scheme and ramification, but differs distinctly in the strongly tuberculate spicules of polyps.

3. *Dendronephthya gigantea* (VERRILL)

(Fig. 3; Plate IX, Figs. 3, 4)

Spongodes gigantea, VERRILL (1864, p. 40).

Spongodes glomerata, STUDER (1888, p. 70).

Dendronephthya gigantea, KÜKENTHAL (1905, p. 549; 1906, p. 39), THOMSON & MACKINNON (1910, p. 184), THOMSON & DEAN (1931, p. 105), ROXAS (1933, p. 435).

Glomerate colony with flat base, broadly encrusting on rock or stones. In largest one examined, polyparium, consisting of several erect, stout columnar main stems and branches, is 19 cm in height and 3-4 cm in diameter of largest stem at base and sterile stalk 5-6 cm in height. Base of lowest branches distinctly foliaceous and forms a collar almost completely encircling the stem.

Polyps densely grouped in large rounded masses of 5-15 at tips of 2-3 mm long twigs. In young colonies polyp-bearing twigs compactly crowded all over the surface, so that the underlying main stem and branches may be completely hidden.

Polyp head more or less rounded, rather large, about 0.6 mm long and 0.9 mm wide, making a very obtuse angle with short and plump polyp stalk less than 1 mm long. Anthocodial armature in eight double rows, about 5 to 6 in a row. Uppermost points usually twice as long as the rest and wholly covered by epidermis, even toward their tips; uppermost one on each lateral side often markedly predominates up to 0.7×0.07 mm, strongly projecting far out of head, and if so, invariably tipped with white. S.B. strongly developed, composed of 3-7 spicules wholly covered with prominent warts, of which one or two are as long as 4 mm and project beyond polyp head for about 1-1.5 mm long. Tentacle spicules apparently absent, but when present, may be of small oval rod of red color, sparsely disposed basally. Ventral side of polyp stalk just below head free from spicules. Anthocodial formula:

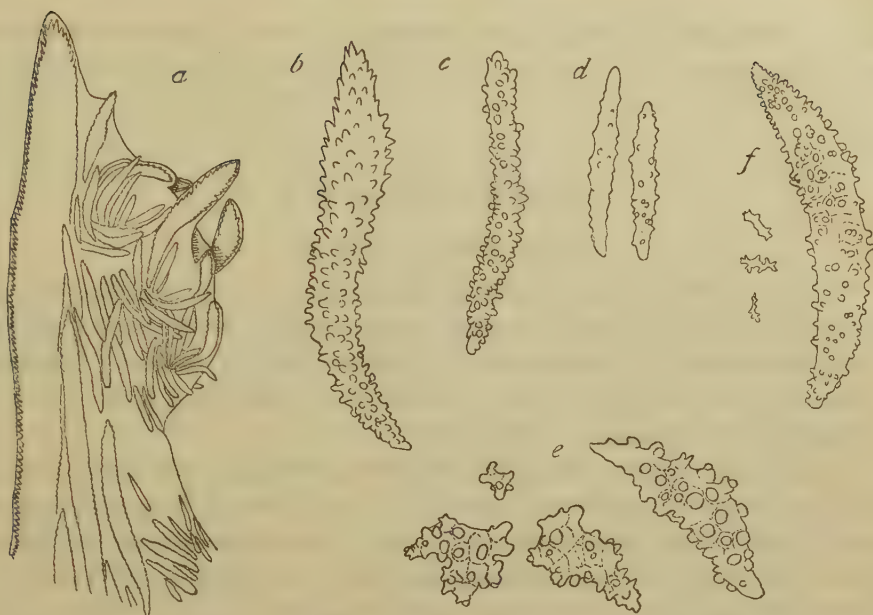


Fig. 3. *Dendronephthya gigantea* (VERR.). a, Polyp; b, strongly projecting uppermost point in laterals; c, slightly projecting uppermost point; d, lower point spicules; e, spicules from lower cortex; f, spindle and antlets from canal-walls. (a, $f \times 35$, $e \times 55$, $b-d \times 80$)

III=1P+ (4-5)p+0 Cr+very strong S.B.+ (0 or 1) M

On cortex of upper stem and branches are large spindles about 4 mm long, covered with large, simply rounded and rugged or compound warts, mostly lying transversely. Lower cortex and canal-walls contain smaller and stouter, heavily warted spindles, triradiates and multiradiates, about 0.08-0.8 mm long and 0.017 mm wide. Besides much smaller, quite irregular forms somewhat like antler type may be seen.

Coloring. Very variable, but generally polyps are red or reddish orange. S.B. spicules and projecting tip of uppermost points white, often yellow to orange. Branch and stem white or whitish yellow. Stalk yellowish, orange or reddish.

Locality. Very common in the littoral of Kii coast, probably all around the southern coast of Japan.

Previously recorded from Japan, Hongkong, Philippines, Malay Archipelago and Amirante (Indian Ocean), from 1 to 200 m in depth.

Remarks. KÜKENTHAL (1905), on examining the original specimens of HOLM, expressed the opinion that *Spongodes aspera* HOLM (1895) from Hirudo (=Hirado) Strait is merely a synonym of *D. gigantea*. However I suspect its identity because of the remarkable differences in coloration and spiculation,

especially of the polyps. It is in all probability a young form of *Dendronephthya suensoni* (HOLM).

4. *Dendronephthya aurea* n. sp.

(Fig. 4; Plate IX, Fig. 7)

The mode of branching and habit correspond exactly with those of the preceding *D. nipponica* and *D. gigantea*, being markedly of the glomerate type and having foliaceous lowest branches at the base of polyparium. Therefore the colony also must be included in KÜKENTHAL's *hemprichi*-group. But the coloration is quite different.

Largest one among a number of examined colonies has a total height of 17 cm of which about 3 cm belongs to sterile stalk. Polyps in compact groups of 5-10. Polyp head flat cuplike, about 0.44-0.55 mm long and 0.7-0.97 mm wide, standing at a very obtuse angle with short stalk up to 1 mm long. Anthocodial armature in eight double rows, about 5-6 in a row. Point spicules of subequal length, about 0.25-0.35 mm long, mostly 0.3 mm long and 0.035 mm wide; the outermost one or a pair up to 0.35-0.5 mm long and 0.05 mm



Fig. 4. *Dendronephthya aurea* n. sp. a, Polyp; b, tip of S.B. spicule; c, part of spindle from upper cortex; d, spindles from lower cortex; e, spicules from canal-walls. (a×35, b-e×55)

wide, broadly tipped, sometimes markedly extend beyond polyp head. Tentacles white, small and apparently devoid of spicules. S.B. strongly developed, composed of 1-3 strong warty spindles, about 2.5-3.5 mm long and 0.26-0.3 mm wide; projecting tip for about 0.5-1.0 mm long strongly spinose towards ends. Polyp stalk very plump and on ventral side with a few small spicules only basally. These spicules are all apricot-orange in color. Anthocodial formula:

$$\text{III} = 1\text{P} + (4-5)\text{p} + 0 \text{ Cr} + \text{very strong S.B.} + (0-1)\text{M}$$

On upper cortex are all white spindles up to 3 mm long and 0.3 mm wide, with close-set rounded warts jagged terminally. On lower cortex are greyish yellow warty spindles up to 1.5 mm long and 0.17 mm wide, and also much smaller ones, mostly 0.3-0.4 mm long, no triradiates being found. Canal-walls thickly filled with colorless, plump spindles with few warts up to 1.8 × 0.23 mm, triradiates and smaller rods, about 0.17 mm long.

Coloring. Stalk greyish yellow, branch cortex white, polyp and S.B. spicules gold-yellow to orange, while polyps themselves yellowish white.

Locality. Very common around Kii coast, just below low-tide level.

5. *Dendronephthya aculeata* KÜKENTHAL

(Fig. 5; Plate IX, Fig. 6)

Dendronephthya aculeata, KÜKENTHAL (1905, p. 559).

D. aculeata (sic), ROXAS (1933, p. 438).

A very compact and rigid colony with a very short stalk completely hidden. Polyparium of a roughly long oval outline, about 8 cm high and 3.5-4.5 cm broad, with about eight main branches completely covered with roundly headed groups of twigs. Lowest branches foliaceous. All polyps superficial, being located at ends of closely massed twigs, so that any bare cortex of stem and branches is entirely invisible from outsides.

Polyps in groups of 6-15 at ends of dichotomously branched twigs. Polyp head small, about 0.4-0.6 mm long and 0.6-0.8 mm wide, standing at an obtuse or right angle with polyp stalk about 0.6-1 mm long. Anthocodial armature in eight double rows, 4-5 in a row. One of the outermost pair larger and extends far beyond polyp head; its projecting tip thickly covered with upward-directing prominent warts. Shorter lower points in obtusely converging 3-4 pairs, sometimes in closely disposed transverse rows, apparently suggestive of 'pseudo-crowns.' S.B. strongly developed, composed of 4 or more strongly spinose spindles up to 3 mm long, more than one of which project for 0.4-1

mm beyond polyp head. Tentacles with simple rodlike spicules up to 0.05mm long, closely disposed in two rows. On ventral side of polyp stalk are large accessory spicules, about 0.6–0.7 mm long, closely arranged obliquely. Anthocodial formula:

$$IV=1P+(3-4)p+0\text{ Cr}+\text{strong S.B.}+2M.$$



Fig. 5. *Dendronephthya aculeata* KÜKTH. a, Polyp; b, uppermost point; c, spicules from lower cortex; d, spicules from upper cortex; e, tentacle spicule; f, spicules from canal-walls. (a, c, d, f×35, b, e×150)

On cortex of branches and twigs are rather small spindles about 0.6 mm long, with numerous close-set conical warts; in foliaceous branches however attaining as long as 4 mm. On basal cortex are smaller spindles, which pass to very tiny stars with rounded stronger warts, about 0.05–0.7 mm across. In canal-walls there are many flat spindles or discs with blunt warts; 0.17×0.03 mm, 0.26×0.05 mm, 0.37×0.05 mm.

Coloring. Stem and branches white, polyp head and upper part of S.B. dark red, paler towards polyp stalk where it is orangish to yellow.

Locality. Kii-ōsima. 1940. S. SAKAGUCHI leg.

Previously recorded from Nagasaki (Japan) and Mindoro (Philippines).

6. *Dendronephthya spinifera* (HOLM)

(Fig. 6)

Spongodes spinifera, HOLM (1895, p. 37), HICKSON (1903, p. 485).

Dendronephthya spinifera, KÜKENTHAL (1905, p. 567), ROXAS (1933, p. 436), MACFADYEN (1936, p. 63).

A small fragment, consisting only of terminal branches in a hemispherical contour, measures about 2.9 cm in height and 3.2 cm in maximum expanse. Most of the polyparium and sterile stalk are missing. However the spiculation of polyps as well as its coloration exactly corresponds with former descriptions of *D. spinifera*, which is hitherto unknown from Japan.

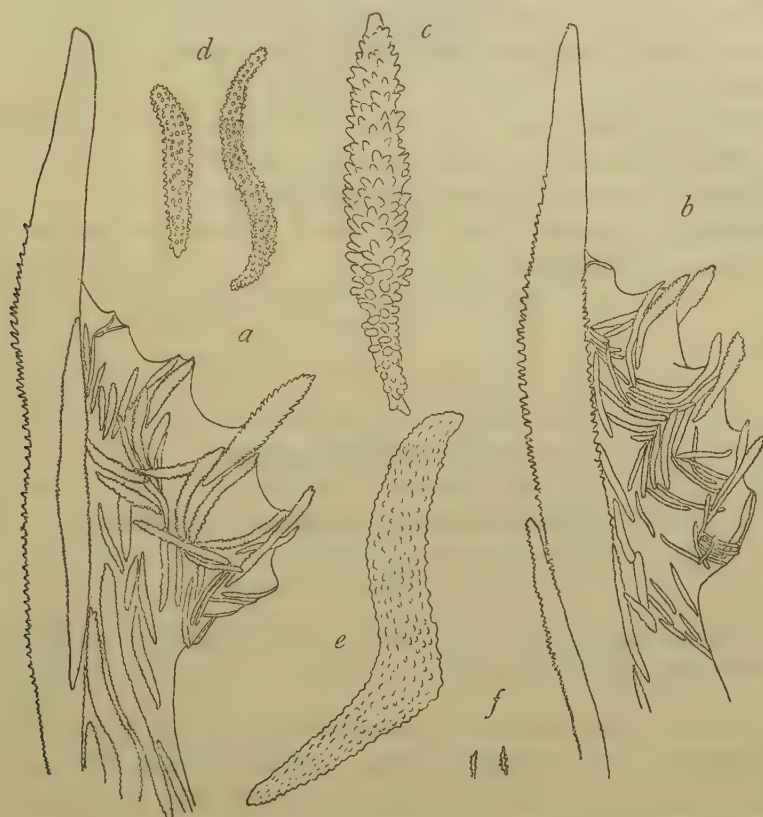


Fig. 6. *Dendronephthya spinifera* (HOLM). a, b, Polyp; c, uppermost point spicule; d, spindles from upper cortex; e, curved spindle from canal-walls; f, flat rod from canal-walls. (a, b, d, f $\times 35$, e $\times 80$)

Polyps compactly massed in a group of 5-12. Polyp head standing at a very obtuse angle with long stalk about 0.6-1 mm long, mostly elongated dorsoventrally and somewhat compressed laterally, measuring about 0.5 mm long and 1.2 mm wide. Anthocodial armature in eight widely separate points, consisting of 4 to 6 in three lateral rows and 1 to 4 in each row on dorsal and ventral sides. One or a pair of outermost points in lateral rows considerably larger than the rest and project for 0.5 mm long beyond polyp head. Intermediate spicules usually absent. S.B. composed of 3 to 7 large spindles,

of which one or two may be as long as 3.5 mm, and strongly project out of polyp head for about 0.7-1 mm long; projecting tip more or less spinose basally but almost smooth distally. Anthocodial formula :

$$IV=1P+(4-6)p+0\text{ Cr}+\text{very strong S.B.}+0\text{ M}$$

Cortical spicules of terminal branches are slender spindles mostly less than 1.5 mm in length, covered with close-set small rounded warts. Canal-walls thickly filled with plump spindles with low warts, up to 2.5 mm long and 0.26 mm wide; many tiny, toothed flat rods, at most 0.05-0.1 mm long, are also found.

Coloring. General color of polyps is brilliant coral-red, projecting tips of S.B. often whitish and cortex of branches white.

Locality. Tomioka, Amakusa Island (Kyusyu).

Previously recorded from Viti Islands, Great Barrier Reef, Maldivé Archipelago and Philippines.

II. DIVARICATAE

7. *Dendronephthya japonica* KÜKENTHAL

(Fig. 7; Plate IX, Fig. 8)

Dendronephthya japonica, KÜKENTHAL (1905, p. 576), THOMSON & MACKINNON (1910, p. 185), THOMSON & DEAN (1931, p. 110).

A dark red, divaricate colony, about 14 cm in height of which about one-third is sterile stalk without stolons. Polyparium flattened in one plane, irregular in outline. Another fragment consisting only of a part of terminal branches, about 2.5 cm long and 4 cm wide.

Polyps in groups of 3-10 at ends of diverging twigs loosely located on surface of branches and stem. Polyp head large, rounded, about 0.55-0.7 mm long and 0.7-0.8 mm wide, mostly standing at a right or acute angle with a very slender stalk up to 2 mm long. Point spicules numerous in each row, larger downwards, the number of spicules in each row greatly varies from 6 to 12. At top of space between each point a number of small rodlike spicules are longitudinally or obliquely disposed, so that the distinction between point, tentacle and intermediate spicules may be almost impossible. S.B. composed of 3-7 strong spindles with smaller accessory spicules of which one or two project above polyp head for about 0.35-0.6 mm long. Anthocodial formula :

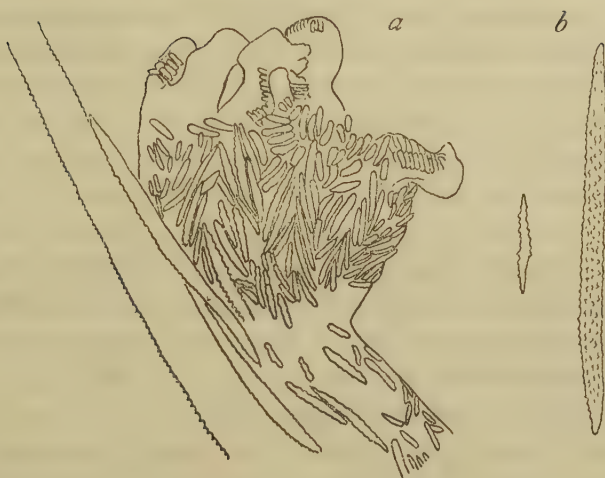


Fig. 7. *Dendronephthya japonica* KÜKTH. a, Polyp; b, spindles from upper cortex. (a×35, b×55)

II=(6-12)p+0 Cr+very strong S.B+many M

Cortex of branches loosely and irregularly disposed with very slender spindles up to 3mm long and .016mm wide, between which much smaller dentate spindles occur abundantly. Canal-walls devoid of spicules.

Coloring. Polyps ochre-yellow, anthocodial and tentacular spicules yellowish white, S.B. and twigs dark red and branch cortex reddish. Stalk dark red.

Localities. Seto and Nada, Kii Coast. 1950. T. YAMAMOTO *leg.*

Previously recorded from S. W. of Japan and Roma Island (Malay Archipelago).

8. *Dendronephthya palmata* n. sp.

(Fig. 8; Plate IX, Fig. 9)

Divaricate. A somewhat rigid, treelike colony with a polyparium flattened in one plane and of a roughly circular outline, 10 cm in height and 9 cm in maximum expanse. Seven lowest branches encircling stem decidedly foliaceous, directed downwards. Sterile stalk 2-3 cm long, about one-fourth of total height and with flat base without stolons, having a diameter of about 2 cm. Polyps crowded at ends of short-stalked twigs borne rather loosely on main stem and branches which ramify in a palmate fashion.

Polyps in a group of 3 to 10. Polyp head about 0.6 mm long and 0.76–0.88 mm wide, making an obtuse angle with plump stalk, shorter than 0.5 mm. Anthocodial armature in eight double rows of 6–7 paired spicules; all of sub-equal length, about 0.18–0.25 mm long and 0.016–0.018 mm wide, with few warts and outermost pair not projecting beyond polyp head. 2–4 intermediate spicules, about half as long as point spicules, occur downwards between points. Tentacles with 8 pinnules on each side and with a few flat disc-like red spicules or none at base of aboral side. S.B. spicules relatively short, about 1.5–2.5 mm long and spinose towards projecting tips, up to 0.5 mm long. Polyp stalk armoured with slightly warted spindles arranged in two regular rows on each side. Anthocodial formula:

$$II = (6-7)p + 0Cr + \text{strong S.B.} + (1-2)M$$



Fig. 8. *Dendronephthya palmata* n. sp. a, Polyp; b, arrangement of spicules in tentacle; c, spicules from canal-walls; d, spicules from basal cortex. (a $\times 35$, c, d $\times 55$, b $\times 70$)

On cortex of upper branches are white or red slender warty spindles, up to 4 mm long and 0.18 mm wide, loosely and irregularly disposed. On basal cortex are yellowish white spindles with prominent warts, up to 2.3×0.23 mm, triradiates and quadriradiates, and also numerous capstan-like or irregular-shaped smaller bodies, about 0.08–0.2 mm across. Canal-walls thickly filled with spindles and triradiates with few but prominent warts; 0.3×0.06 mm, 0.6×0.11 mm, 1.5×0.018 mm. No smaller antler-like flat bodies exist.

Coloring. Polyp and S.B. spicules blood-red, but polyps themselves yellow, branch cortex white mottled with red spicules in places, stalk ochre-yellow.

Locality. Tanabe Bay.

Remarks. In general appearance of the colony and polyps, this specimen

comes near to *D. microspiculata* of KÜKENTHAL's *rigida*-group, but the shortness of stalk and the difference of polyp spiculation are so distinctive as to be compelled to establish a new species.

9. *Dendronephthya furcata* n. sp.

(Fig. 9; Plate IX, Fig. 10)

Divaricate. From a blunt base bearing many short stolons, a graceful red-colored colony arises to a height of 12 cm. Sterile stalk, occupying about one-third of total height, very rigid and shrunken with an indication of deep longitudinal furrows. Polyparium markedly flattened, but not uniform in contour, having a broadest expanse of 7 cm. Main stem stands erect and gives rise to three side branches which divide and subdivide into a number of terminal branches and twigs. Widely divergent twigs are borne loosely on bare surface of stem and branches. Lowest two branches broadly expanded with a series of small foliate projections turned downwards.



Fig. 9. *Dendronephthya furcata* n. sp. a, Polyp; b, spindle from upper cortex; c, d, spindle and derivatives from basal cortex; e, flat spicules from canal-walls. (a×35, b-e×55)

Polyps usually in groups of 3-5, sometimes singly, at ends of long, slender, divergent twigs. Polyp head relatively large, about 0.8 mm long and 0.8-1 mm wide, more or less laterally compressed, and making an obtuse angle with

slender polyp stalk about 1-1.5 mm long. Anthocodial armature in eight regularly converging double rows, about 6 in a row. Uppermost one larger, spinose, sharply tipped and extends beyond polyp head. Between points are thickly disposed numerous small intermediate spicules, as many as 15, converging downwards. Tentacles considerably large, heavily armoured with small, toothed, oval or rodlike, reddish spicules, not forming any regular row. S.B. spicules, 4 mm long in largest one, finely and thickly tuberculate almost towards the free tip which projects for about 0.5-1 mm beyond polyp head. Polyp stalk densely disposed with red spindles lying transversely. Anthocodial formula:

$$\text{III}=1\text{P}+5\text{p}+0\text{Cr}+\text{strong S.B.}+\text{many M}$$

On cortex of main stem and branches are transversely disposed red or reddish white spindles with simple conical warts, up to 5 mm long and 0.35 mm wide. On basal cortex are shorter, straight or curved, plump, reddish spindles with compound warts, up to 1.5×0.35 mm, mostly 1.0×0.18 mm, and their derivatives. Canal-walls contain simply toothed, colorless spindles, up to 0.25 mm long, mingled with less-warted, almost flat triradiates and stellate forms.

Coloring. All polyps, terminal twigs and lower foliaceous branches red, cortex of main stem, branches and stalk pale red.

Locality. Tanabe Bay.

Remarks. In the mode of branching and anthocodial armature this specimen approaches to *D. depressa* and *D. rosea*, recorded by KÜKENTHAL (1896) from Ternate, both belonging to KÜKENTHAL's *rigida*-group of the Divaricatae, and also *D. flabellifera* of the Umbellatae, known from Japan. But it does not agree with either of them in detailed structure of spiculation as well as in coloration.

10. *Dendronephthya alba* n. sp.

(Fig. 10; Plate X, Fig. 26)

A very rigid, entirely glistening white colony of a markedly spiny appearance. Polyparium distinctly flattened, not uniform in outline and measures about 6.5 cm in length and 6 cm in maximum breadth. Main branches ended in rounded contour, with densely crowded twigs, and widely apart from one another. Lowest branches, more than 5 in number, markedly foliaceous, but not forming a continuous collar around stem. Sterile stalk, about one-third of total height of the colony, very rigid, columnar, and with a flat base bearing short stolons; its height as well as basal diameter about 2.5 cm.

Polyps in groups of 3-10 at ends of twigs. Polyp head compressed late-

rally, about 0.7 mm long and 0.8–0.9 mm wide, making a right or obtuse angle with slender polyp stalk about 1–1.5 mm long. Anthocodial armature in eight double rows, 6–7 in a row. One of uppermost pair large, hockey-club-like in shape, up to 0.8 mm long on lateral sides, while at most 0.5 mm long in two ventral rows, and extends prominently beyond polyp head; the other one about

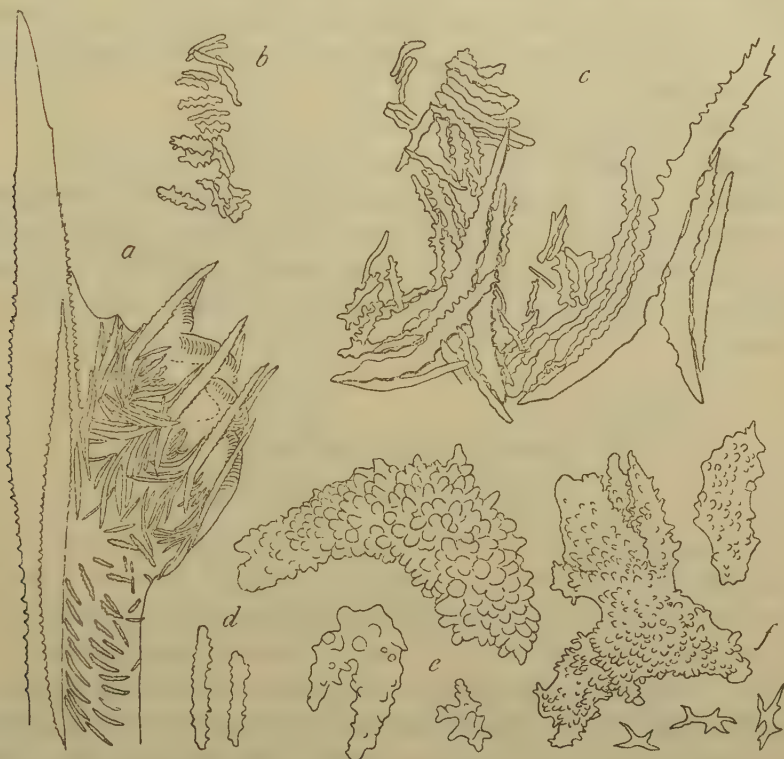


Fig. 10. *Dendronephthya alba* n. sp. a, Polyp; b, arrangement of spicules in tentacle; c, part of anthocodial armature; d, spicules from polyp stalk; e, spicules from lower cortex; f, warty spicules and antler-like flat bodies from canal-walls. (a×35, e, f×55, b–d×100)

one-third as long as the larger one, up to 0.26 mm. Lower points longer downwards up to 0.35 mm long. Between points there are more than 3 pairs of intermediate spicules, about 0.05–0.18 mm long. Tentacles very long, with close-set small spicules, about 0.05 mm long at base, transversely arranged. S.B. very strongly developed; usually only one spicule, up to about 4 mm long and 0.33 mm wide, predominates and projects beyond polyp head for over 1 mm; it is colorless, opaque and densely covered with small conical warts, except at free tip where it is smooth. Ventral side of polyp stalk obliquely disposed with

many small toothed rods of approximately the same length, mostly 0.15×0.02 mm. Anthocodial formula:

$$IV=1P+(5-6)p+0Cr+\text{very strong S.B.}+\text{many M}$$

In cortex of upper stem and branches are numerous slender warty spindles up to 3 mm long, arranged transversely. In cortex of stalk are small plump spindles, triradiates, multiradiates and stellate forms with prominent rounded warts, of various sizes ranging from 0.2 mm to 2 mm long. Canal-walls contain all similar spicules, less than 1.5 mm long, together with antler-like flat bodies up to 0.16 mm long.

Coloring. Glistening white all over.

Locality. Kii-ōsima. 1941. S. SAKAGUCHI *leg.*

Remarks. This form is to be referred to KÜKENTHAL's *cervicornis*-group of the Divaricatae by its irregular contour and distinctly flattened polyparium. Yet it does not agree with any of the known species within this group, especially in the very peculiar spiculation and in the glistening whiteness of the whole colony.

11. *Dendronephthya palaoensis* n. sp.

(Fig. 11; Plate X, Fig. 11)

A handsome flexible, treelike colony, about 12 cm in height and 9 cm in maximum breadth. Sterile stalk flaccid, columnar, less than one-fourth of total height of the colony, and at base forms a membranous expansion terminating into a number of extremely elongate and ramified stolons entangled with debris and sands. Polyparium divaricate in an oval outline and decidedly flattened in one plane. Polyp-bearing twigs borne on all surface of erect stem and branches equally short-stalked, about 2 mm long, and loosely spaced. Lowest branches, 5 in number, slightly foliaceous, but do not form a complete collar around stem.

Polyps in groups of 3 to 10 at ends of twigs. Polyp head laterally compressed, about 0.58 mm long and 0.82 mm wide, standing at an obtuse angle with rather long, stout polyp stalk, often over 1 mm long. Anthocodial armature consists of eight widely spaced double rows, 3 in laterals on either side and each one on dorsal and ventral side, each row consisting of 3-5 pairs of almost smooth, rather large, slender spindles. Uppermost one or a pair in three lateral rows longer (up to 0.6 mm long) than that in ventrals (about 0.45 mm long) and strongly project beyond polyp head. Usually no intermediate spicules occur between points, but if any, very slender, about 0.25 mm long and situated close to tips of uppermost points. Tentacles long, apparently devoid of spicules.

Ventral side of polyp stalk below head almost nude. S.B. strongly developed and composed of one or two strong, finely-warted, bicolored spindles, up to 4 mm long and 0.35 mm wide, together with several smaller, wholly red, accessory spicules, the largest one of which projects for over 1 mm long beyond polyp head, and colored yellow upwards and red downwards. Anthocodial formula :



Fig. 11. *Dendronephthya palaoensis* n. sp. a, Polyp; b, spindles from upper part of stalk; c, spicules from lower part of stalk. (a x 35, b, c x 55)

IV=1P+(2-4)p+0 Cr+very strong S.B.+(0 or 1) M

On cortex of branches and twigs are irregularly and sparsely disposed strongly-warted spindles, either white or red in color, up to 6 mm long, but mostly about 2 mm long. Spiculation of upper portion of stalk is similar to the above. At its lower portion and also stolons are, however, all smaller, irregular-shaped bodies with rounded warts, up to 0.35 mm long. Canal-walls free from spicules.

Coloring. Polyp head (both anthocodial spicules and upper portion of S.B.) yellow, polyp stalk and twigs blood-red, branch and stalk reddish white, due to the combined occurrence of red and white spicules. Base of stalk with stolons greyish with reddish hue.

Locality. Korror Island of the Palao Islands group, on coral platform. 1937. T. YAMANOUCHI leg.

Remarks. The anthocodial architecture of the present specimen appears like that of *D. marenzelleri* of *cervicornis*-group of the Divaricatae, recorded

from Karoline Islands, and also somewhat of *D. köllikeri* of the Glomeratae, recorded also from Palao Islands. However, the growth form, as mentioned above, shows to be referred to *rigida*-group of the Divaricatae. Within this group, however, the specimen does not agree with any of the species included.

12. *Dendronephthya filigrana* KÜKENTHAL

(Fig. 12; Plate XI, Fig. 27)

Divaricate, belonging to KÜKENTHAL'S *rigida*-group. A somewhat flexible colony, about 11 cm long and 8.5 cm wide. Polyparium consists of a tall main stem and three large side branches of similar length, horizontally arising from stem, and flattened in one plane. Lowest branches at top of stalk small and slightly foliaceous. Sterile stalk rather rigid, tall, cylindrical, about 4 cm long and bears many long stolons around its lower half.

Polyp head, about 0.5–0.9 mm long and 0.7 mm wide, standing at a very obtuse angle with long, tapering stalk up to 2 mm long. Anthocodial armature consists of eight double rows of very steeply converging spindles, 2 or 3 in lateral rows and 1 or 2 in dorsal and ventral rows, instead of 5–6 in laterals as described by KÜKENTHAL (1906, p. 44). Uppermost pair larger, spinose and extend freely far out of head, but mostly covered with epithelium; lower points more slender and almost smooth. Intermediate spicules absent. Tentacles

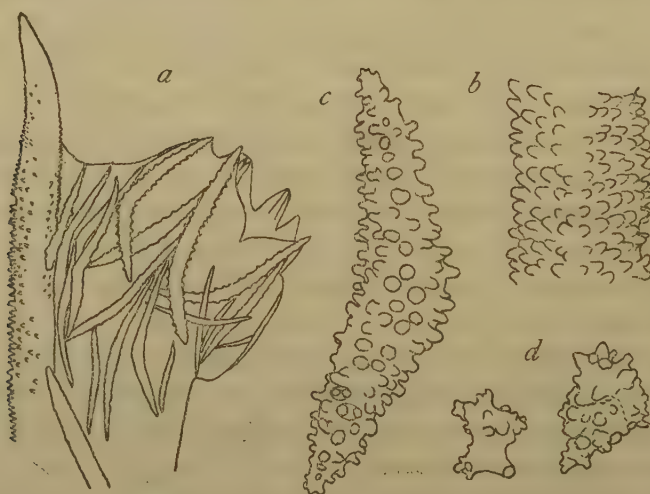


Fig. 12. *Dendronephthya filigrana* KÜKTH. a, Polyp; b, part of spindle from upper cortex, showing the transverse arrangement of conical warts; c, spindle from upper part of stalk; d, stellate forms from lower part of stalk. (a×35, c, d×55, b×70)

with colorless, slightly toothed, flat rods, about 0.08 mm long at base, arranged in 2 rows. S.B. spicules, up to 5.5 mm long, finely spinose, and only one projects for about 1 mm long or more. Anthocodial formula:

$$IV = (2-3)p + 0 \text{ Cr} + \text{very strong S.B.} + 0 \text{ M}$$

In upper cortex are very large spindles, up to 6 mm long and 0.5 mm wide, covered with rounded or conical warts regularly arranged in transverse rows. In stalk cortex are shorter curved spindles up to 1 mm long, becoming downwards to almost globular stellate forms with prominent warts, up to 0.26 mm across. Canal-walls devoid of spicules.

Coloring. Stalk straw-colored, stem and branches white. Polyps and S.B. ochre-yellow.

Locality. Off Minabe, Kii coast, 100-200 m. March 1950.

Previously recorded from Misaki (Japan).

13. *Dendronephthya divaricata* (GRAY)

(Fig. 13; Plate XI, Fig. 29)

Spongodes divaricata, GRAY (1862, p. 29; 1869, p. 123).

Dendronephthya divaricata, KÜKENTHAL (1905, p. 588), THOMSON & MACKINNON (1910, p. 185), ROXAS (1933, p. 443).

A small but complete colony, about 4.5 cm in total length, of which about one-half belongs to sterile stalk. Polyparium with a regular rounded contour of about 1.3 cm in diameter and not flattened laterally. A few short branches at top of long cylindrical stem give off horizontally a number of diverging side branches of similar length. Lower branches foliaceous at top of stalk. Stalk cylindrical, flabby and bears a few slender stolons at base.

Polyp head stands at an obtuse or right angle with long stalk up to 1 mm. Anthocodial armature in eight double rows, mostly 5 in a row; outermost pair larger, about 0.3 mm long and slightly extend beyond polyp head. S.B. strongly developed, composed of three or more finely warted spindles, as long as 2.5 mm, with almost smooth tip extending for about 0.6 mm long beyond polyp head. Tentacle spicules of colorless, slightly toothed flat rods, about 0.07 mm long, closely packed in two rows. Anthocodial formula:

$$IV = 1P + (3-5)p + 0 \text{ Cr} + \text{strong S.B.} + (1-2)M$$

In upper cortex are colorless, slender, mostly curved spindles with fine warts, up to 2 mm long. In basal cortex are white or rosy, plump spindles with strong warts, about 0.5×0.09 mm, becoming sparse downwards. In addition many rosy or uncolored, small triradiates, quadriradiates and irregular forms, about

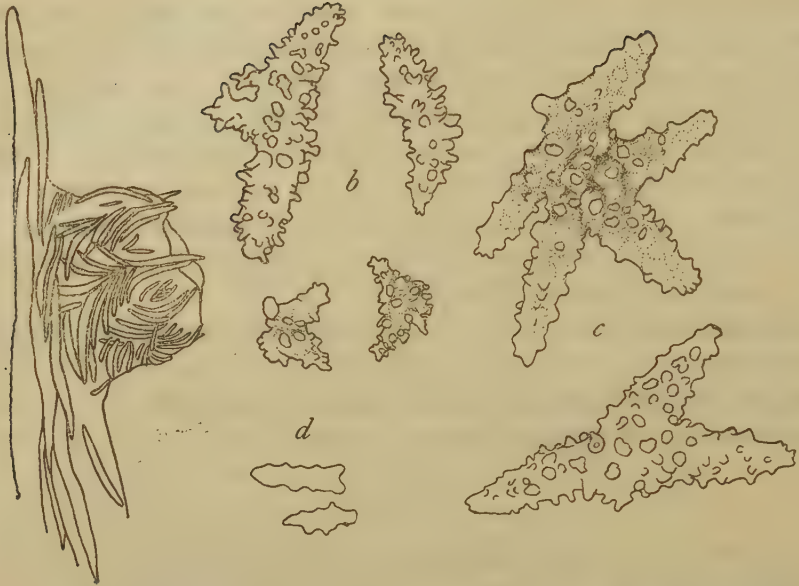


Fig. 13. *Dendronephthya divaricata* (GRAY). a, Polyp; b, spicules from lower cortex; c, spicules from canal-walls; d, tentacle spicules. (a $\times 35$, b, c $\times 70$, d $\times 150$)

0.05-0.2 mm long, are found. Canal-walls contain mostly stout triradiates, quadriradiates and multiradiates with compound warts, up to 1.2×0.17 mm.

Coloring. Wholly white, except at lower half of stalk where it is tinged with a rosy hue. Polyp itself slightly cream-colored.

Locality. Tanabe Bay, 10-20 m.

Previously recorded from New Guinea, Philippines and Indian Ocean (Providence and Mauritius).

14. *Dendronephthya golgotha* n. sp.

(Fig. 14; Plate X, Fig. 12)

A flexible treelike colony of irregular branchings. In a complete specimen, about 10 cm high, polyparium is distinctly flattened in one plane, but not uniform in contour, and stalk about one-fifth of total height of the colony. In another fragment without stalk, polyparium not distinctly flattened and irregular in outline. In both specimens, upper branches are cylindrical, rather uniform in diameter and wrinkled transversely, and terminate in slightly diverging twigs; the mode of branching is thus suggestive of the divaricate form of the *Glomeratae*. A number of short polyp-bearing twigs are borne sparsely on all surface

of stem and branches. Lowest branches, numerous in number, at top of stalk distinctly foliaceous, but do not form a collar. Sterile stalk cylindrical, wider than high, and bears short stolons around flat base, about 2.5 cm in diameter.

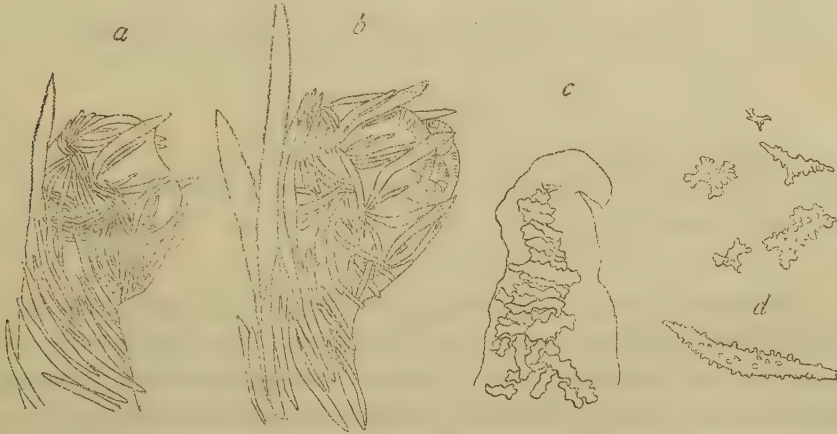


Fig. 14. *Dendronephthya golgotha* n. sp. a, b, Polyp; c, arrangement of spicules in tentacle; d, spicules from stalk cortex. (a, b, d $\times 35$, c $\times 100$)

Polyps in groups of 5-10 at ends of twigs. Polyp head small, about 0.35-0.45 mm long and 0.5-0.3 mm wide, making an obtuse angle with polyp stalk, shorter than 1 mm. Anthocodial armature in eight points consisting of a single pair of highly projecting spindles, often associated with a much smaller one at its base. Below points there are 4-6 'pseudo-crown' spicules, of which 1 or 2 are horizontally disposed, and 3 or 4 in converging pairs below. 1-3 much smaller intermediate spicules occur between points. Tentacles with red, toothed flat rods, about 0.05-0.1 mm long, closely disposed in two rows. S.B. projects beyond polyp head for up to 1 mm long, mostly 0.3-0.6 mm long; its spicules rather short, at most 2 mm long and 0.15 mm wide, and finely spinose throughout. Polyp stalk densely disposed with large spindles on ventral side. Anthocodial formula:

$$VI=1P+(4-6)Cr+strong\ S.B.+(0-1)M$$

On cortex of branches are slender spindles with minute warts transversely arranged; 0.3×0.04 mm, 0.8×0.07 mm, 1.1×0.07 mm. On cortex of stalk are smaller spindles less than 0.7 mm long, but mostly much more tiny star-shaped bodies about 0.08-0.3 mm across. Canal-walls devoid of spicules.

Coloring. Branch and stalk white, polyp and S.B. spicules blood-red, while polyps themselves yellowish white.

Locality. Kii-ôshima. 1940. S. SAKAGUCHI leg.

Remarks. The general appearance of the colony as well as the anthocodial armature approaches closely to *D. suenisoni* (HOLM) recorded from Japan.

But it differs from the latter in the absence of spicules in canal-walls and in the smallness of polyps with a relatively short stalk.

15. *Dendronephthya cervicornis* (WRIGHT & STUDER)

(Fig. 15; Plate X, Fig. 13)

Spongodes cervicornis, WRIGHT & STUDER (1889, p. 220), HICKSON & HILES (1900, p. 498).

Sp. rhodosticta, WRIGHT & STUDER (1889, p. 218), HICKSON & HILES (1900, p. 498.).

Dendronephthya cervicornis, KÜKENTHAL (1905, p. 592), THOMSON & HENDERSON (1909), THOMSON & DEAN (1931, p. 118), ROXAS (1933, p. 446).

A very flexible, divaricate colony with slender branchings of no uniform contour, distinctly flattened in one plane. There are in the collection three specimens of which the largest one has a flattened polyparium, about 8 cm long and 6 cm wide, the stalk being missing. In the other smaller one, the total height is 6 cm of which 1.5 cm is the stalk, about 6 mm in basal diameter. Lowest branches of both specimens are slightly foliaceous.

Polyps in rather divergent groups of 3 to 8 at ends of twigs. Polyp head about 0.5 mm long and 0.62 mm wide, standing at a right angle with stalk shorter than 1 mm. Anthocodial armature consists of only one pair of points, of which one projecting, 0.35–0.5 mm long, beyond polyp head, and below these

usually 2 horizontally disposed and 2 or 3 converging crown spicules; between points usually occurs a single small intermediate spicule or none. Anthocodial formula:

$$VI=1P+(4-5)Cr+strong\ S.B.+ (0-\frac{1}{2})M$$

Cortical spicules on branches and stalk are irregularly disposed red or reddish white spindles, about 1.7–2 mm long, with minute warts, often almost smooth in smaller ones. No other kind of spicules is found. Canal-walls apparently devoid of spicules.

Coloring. On the whole purplish-red, becoming paler downwards, dependant on predominance of white spicules there, but polyps themselves are greyish yellow.

Locality. Seto.

Previously recorded from Tahiti, Funafuti, Kei, Lifu and Andaman Islands, and also from Philippines.

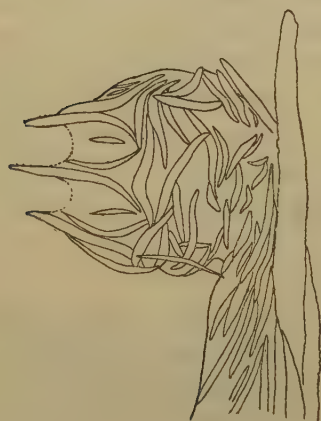


Fig. 15. *Dendronephthya cervicornis*
(WR. & ST.). Polyp. (×35)

Remarks. The anthocodial spiculation of the present specimens conforms well with that of *D. cervicornis*. The general color scheme and cortical spiculation seem to be somewhat different from previous descriptions. However I feel justified in assigning it to this species, since some slight disagreement in the general color scheme, cortical spiculation and in the proportion of stalk to polyparium seems negligible, as most of former authors recognize.

16. *Dendronephthya decussatospinosa* n. sp.

(Fig. 16; Plate XI, Fig. 25)

A tall divaricate colony of a very unique appearance, about 19 cm in total height. Stalk very tall, about 15 cm high, flexible and cylindrical gradually tapering upwards; its diameter is about 1 cm at top and 2 cm at base. Base is slightly mutilated, so that it may not be discriminated whether stolons practically occur or not. Polyparium distinctly flattened in a uniform contour wider than high; from an erect main stem two side branches (a longer up and a shorter below) are given off prependicularly on each side. Base of two lowest branches distinctly foliaceous, turned downwards and faced to each other along the long axis of stem.

Polyps in groups of 3-10 at ends of twigs loosely spaced. Polyp head stands at a right angle with polyp stalk about 1 mm long; its contour roundly depressed, nearly octagonal as seen from above, about 0.6 mm in diameter and 0.45 mm in height, if including projecting point spicules also, attaining to 0.7 mm in height. Anthocodial armature shows eight points, usually crossed over the mouth, each point consisting of a very long, prominently projecting, hockey-club-like spindle (about 0.6 mm long) and a much smaller one (about 0.25-0.4 mm long). Below these points 3 horizontals and 3-4 converging pairs are closely disposed. Intermediate spicules are mostly only one, but rarely 2 or 3, its being 0.12 mm long. Tentacles with elongate rods, up to 0.047 mm long, arranged bilinearly. S.B. very strongly developed, one or two spicules extending far beyond polyp head for over 1 mm long, often 1.5 mm long, with smooth free tip. All these spicules hyaline and finely spinose. Anthocodial formula:

$$VI=(1-2)P+(6-7)Cr+very\ strong\ S.B.+ (\frac{1}{2}-1)M$$

On cortex of main stem and branches are densely disposed short, hyaline spindles with small simple warts, up to 0.8 mm long and 0.1 mm wide. On cortex of sterile stalk are closely disposed small, white or rosy, star-shaped warty bodies from 0.2 mm to 0.9 mm across; they gradually become larger downwards and at the base a few short spindles are also found. Canal-walls

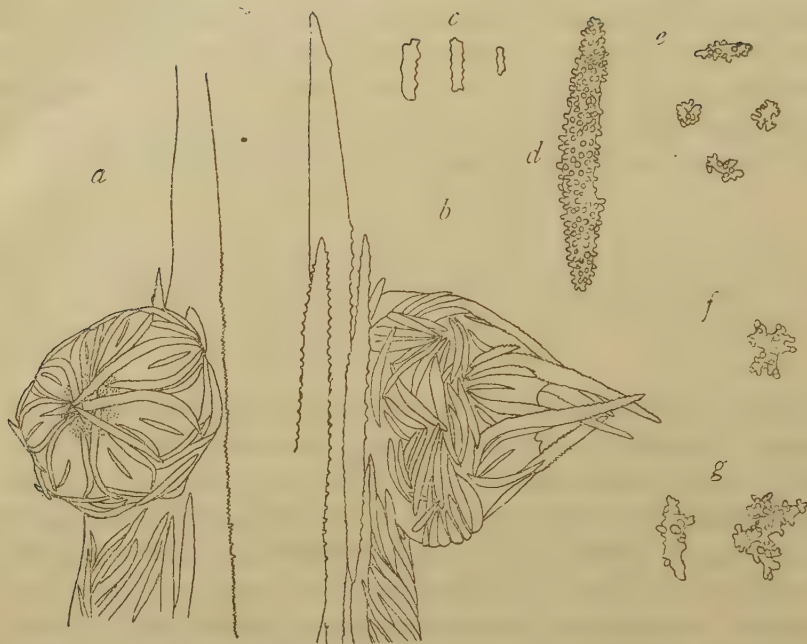


Fig. 16. *Dendronephthya decussatospinosa* n. sp. a, Polyp, ventral view; b, polyp, lateral view; c, tentacle spicules; d, spindle from upper cortex; e-g, cortical spicules from upper (e), middle (f) and lower (g) parts of stalk. (c×150, all the others×55)

devoid of spicules, only showing a lozenge-shaped network of solenia.

Coloring. Polyparium wholly grossy-white, sterile stalk pink, paler upwards.

Locality. Seto.

Remarks. In the mode of branching this form must be included in KÜKENTHAL's *rigida*-group, within which it does not agree with any known species.

III. UMBELLATAE

17. *Dendronephthya dromidicola* n. sp.

(Fig. 17; Plate X, Fig. 15)

A very large, flaccid colony covering upon the back of the dromiid crab, *Dromidiopsis dromia* (LINNÉ), having a height of about 10 cm (when alive, attaining to 15 cm in an expanded condition) and a polyparium expanse of

19×18 cm. Another specimen showing the same habit has a polyparium expanse of 12×5 cm.

Basal attachment very broad, flattened with a maximum diameter of 11 cm, and entirely bare. It gives rise on upper surface to six very plump main branches of approximately the same length, which in turn divide into terminal short twigs where the polyps are located. Terminal twigs in form of umbels grouped together to form hemispherical clusters, all umbels being formed superficially on outer surface of polyparium. Lowest branches, surrounding the base are all short and slightly foliaceous, but located at a height of about 1 cm only from the base, so that ordinary stalk portion may not be delimited from the basal disc proper, nor from the polyparium.

At each end of terminal twigs, about 1.5-1.8 mm in diameter, usually 5 or 6 polyp groups are located. In each group, 5 to 10 polyps are closely massed and share a single supporting bundle. Therefore, a largest terminal polyp only bears it, while the other additional smaller ones have none. In many cases, a twig bears only a prominently developed S.B. (composed of about 5 strong spindles) and several less-developed S.B. (composed of 1-3 smaller spicules); in the former case, spicules composing the bundle are as long as 8.5 mm and may project for about 3-4 mm long beyond polyp head terminally located, while in the latter they are shorter than 2 mm and do not project beyond polyp head. In every case, main polyps may stand almost upright, extending parallel to S.B.

Polyp head rounded, rather small, about 0.28-0.4 mm long and 0.4-0.52 mm wide. Polyp stalk very plump, a little narrower than head, and rather short, though varying in size. Anthocodial armature very characteristic, showing the most primitive feature belonging to Grade I. Anthocodial spicules are very numerous, small, densely packed rods in eight converging points, mostly not forming any regular double rows; usually those of upper and inner parts are yellow or yellowish white, while those of basal and outer parts brownish red in color. Largest polyp spicule is about 0.07 mm long and 0.017 mm wide, although many are much smaller. In tentacles also are numerous tiny, similar spicules arranged transversely, usually yellowish white, but often merged with reddish ones as in polyp heads, measuring about 0.014-0.028 mm long and 0.005 mm wide. Below polyp head also numerous brownish red-colored tiny rods are sparsely set on all surface of cortex from polyp stalk down to terminal branches; they are often arranged in eight longitudinal rows on polyp stalk only, but become more irregular and sparse downwards; about 0.07×0.008 mm, 0.05×0.017 mm, 0.14×0.026 mm. S.B. spicules are all slender spindles covered with close-set minute low warts all over and always orange-colored, deepest

at middle. Anthocodial formula:

I=many p+0 Cr+very strong S.B.

In cortex of branches, there are also slender spindles similar to those of S.B., about 2-7 mm long, though much more sparse than tiny rods. They are longitudinally disposed and orange-colored in upper branches, but become downwards much more sparse and paler to yellowish in color. Basal cortex free from spicules, except for around the lowest branches. Canal-walls relatively thick, fleshy in texture and also devoid of spicules.

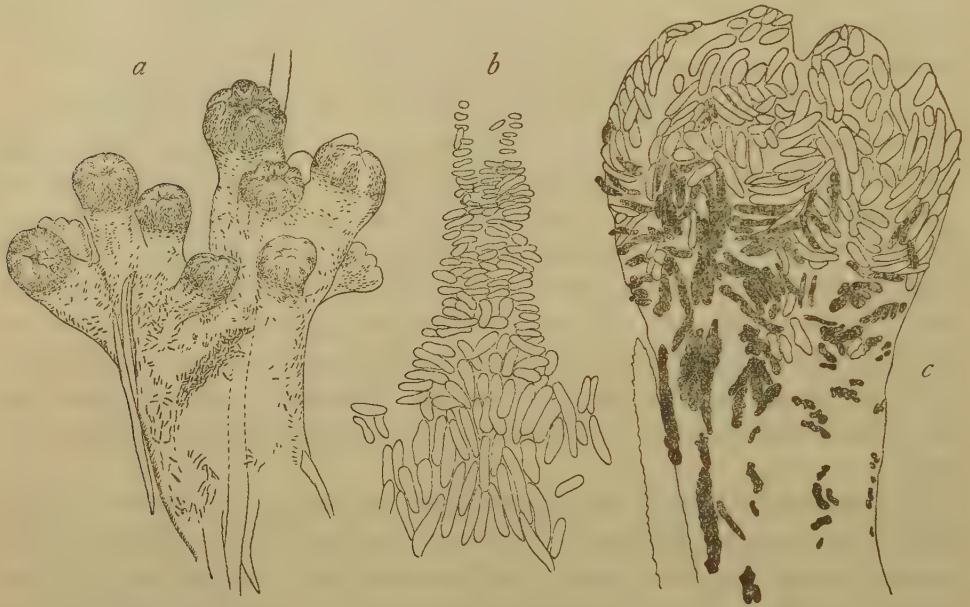


Fig. 17. *Dendronephthya dromidicola* n. sp. a, Terminal twig bearing a number of polyps supported by a single bundle of spicules; b, arrangement of tentacle spicules continued insensibly into point spicules; c, terminal polyp, showing the arrangement of red-colored (black outlined) and yellow-colored (white outlined) spicules. (a×18, c×80, b×150)

Coloring. On the whole terminal twigs and polyps reddish-orange, branches and basal cortex yellowish-white.

Locality. (Holotype) Tanabe Bay, 5 m. Nov. 23, 1951; (Paratype) Tanabe Bay. April 19, 1952. T. YAMAMOTO leg.

Remarks. In polyp spiculation this interesting form comes nearest to *D. repens* of KÜKENTHAL's *rubra*-group and also to *D. villosa* of *dendrophyta*-group, both belonging to the *Umbellatae* division. Yet the general mode of branching may conform with the type of *collaris*-group. In general branching and spiculation, the present form seems to be allied to *Spongodes capitata* from Hongkong, which was described by VERRILL (1864, p. 40; 1865, p. 193)

very briefly without any figure and later treated by KÜKENTHAL (1905, p. 708) only as '*Species incertae sedis*' of *Dendronephthya*. However, it is now very doubtful if both are the same species. To solve this question, re-examination of VERRILL's type specimens, if still present, is much desirable. Therefore, I herewith tentatively describe the present form as a new species belonging to the Umbellatae group.

The chief interest lies, however, in the following peculiarities:

- (1) Cortical spicules consists of two types only, rod and spindle. No specialized spicule exists.
- (2) Rodlike spicules are very tiny, numerous and almost similar to one another in every portion of tentacles, polyps and branches.
- (3) S.B. spicules and cortical spicules of spindle form are similar in structure and insensibly connected together.
- (4) A number of polyps at ends of twigs are supported only by a common bundle of spicules located on the dorsal side of parent polyp stalk.
- (5) Weak spiculation of cortex and no spiculation of canal-walls, together with the thickness of canal-walls, are very distinctive.

These outstanding features may speak for this form to be the most primitive form of this group, having an affinity with the Alcyoniidae. The habit is also remarkable and very peculiar for this group. It is hard at present to tell whether this lodgment on the back of the dromiid crab is natural or commensal, or else only accidental. However, it may not be an unusual example, since I have ever obtained here another kind of the crab, *Dromidia unidentata*, carrying an *Alcyonium*-like colony on the back. In the recesses of the polyparium there lay a number of a commensal polynoid, *Scalisetosus levis* MARENZELLER, and a pair of a white-colored snapping shrimp, *Synalpheus* sp., as in other examples of *Dendronephthya*.

18. *Dendronephthya spinulosa* (GRAY)

(Fig. 18; Plate X, Fig. 14)

Morchellana spinulosa, GRAY (1862, p. 30; 1869, p. 130).

Spongodes spinulosa, RIDLEY (1882, p. 186).

Dendronephthya spinulosa, KÜKENTHAL (1905, p. 681).

A large, flexible, long-stalked colony with umbellate polyparium; its total height is about 30 cm of which 22 cm belongs to the stalk. Stalk flexible, apparently leathery in texture, cylindrical, gradually narrower upwards and at

its base furnished with some large tubular stolons entangled with sand and shell particles; its lower half is thickly covered with colonies of a bryozoan, *Barenia discreta*. Polyparium distinctly flattened in one plane and formed of an erect main stem and five long, cylindrical side branches of different lengths; these branches are widely apart so that the outline of polyparium is irregular. In addition, at the base of polyparium there are two broad foliate branches, turned downwards, below which the stem is somewhat constricted.

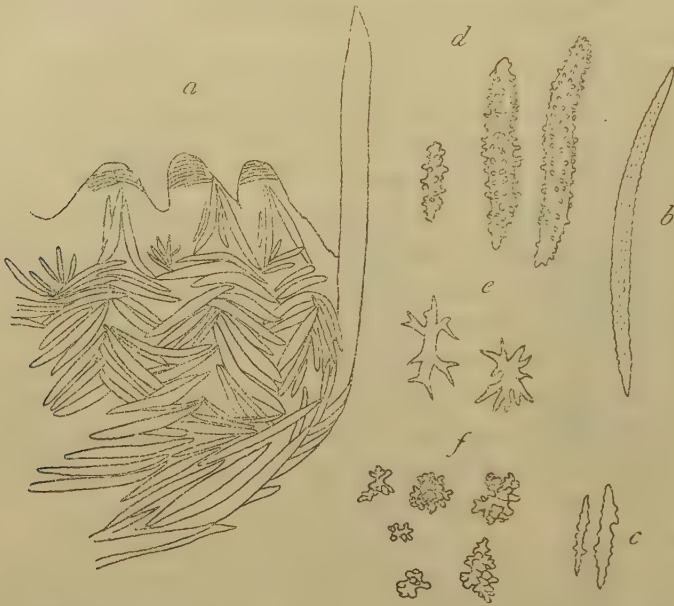


Fig. 18. *Dendronephthya spinulosa* (GRAY). *a*, Polyp; *b*, spindle from polyp stalk; *c*, tentacle spicules; *d*, spindles from upper cortex; *e*, antler-like flat bodies from canal-walls of branches; *f*, stellate spicules from stalk cortex. (*b*, *d*, *f* $\times 55$, *a* $\times 70$, *c*, *e* $\times 150$)

Polyp groups occurring on terminal twigs are almost collapsed and brittle. Polyp head very small, about 0.4 mm long and as many wide, standing at an obtuse or almost right angle with very short polyp stalk. Anthocodial armature in eight double rows, 10-12 in a row. Uppermost one or two pairs a little longer and longitudinally disposed, below these 8-10 converging pairs closely disposed. All these spicules are weakly warted spindles of subequal length, about 0.13-0.17 mm long in transverse rows. Two pairs of small intermediate spicules are usually found between uppermost points. Tentacle spicules white or reddish, elongate, toothed flat rods with sharp ends, about 0.07 mm long at base. S.B. of the entheathing type, as in *D. annectens* SHERRIFFS, and very inconspicuous, but in polyps occurring on lowest foliaceous branches 1 to

3 spicules somewhat prominent and slightly project out of polyp head. Anthocodial formula:

$$II=(10-12)p+0\text{ Cr}+\text{very weak S.B.}+2\text{ M}$$

Very noteworthy is the spiculation of cortex: In cortex of stem and branches are thickly warted spindles up to 2.5 mm long and 0.23 mm wide, but mostly smaller spindles, from 0.17×0.03 mm to 1.1×0.1 mm. In cortex of stalk are densely disposed small capstan-like or star-shaped almost globular warty spicules, about 0.07-0.14 mm across. In canal-walls of twigs, there are antler-like flat discs, about 0.065-0.075 mm long in abundance, but those become fewer downwards in branches and main stem; in stalk these antlers are not found at all.

Coloring. Polyp spicules purplish-red, other cortex reddish, paler upwards and darker downwards, leading to brick or brownish red towards the basal portion of stalk.

Locality. Tanabe Bay, 20 m.

Previously recorded from Indian Ocean and China Sea.

Remarks. In general coloration and anthocodial architecture, this specimen resembles closely *D. spinulosa* described and figured by KÜKENTHAL (1905), except as regards the details of spiculation. The outstanding disagreements may be the following three points:

- (1) The number of point spicules in a row is more numerous.
- (2) The tentacle spicules are elongate, instead of being short and broad.
- (3) In canal-walls, spindles or allied spicules are not found.

KÜKENTHAL, however, recognizes that there is considerable variability in this species. His examined specimens may be rather younger forms, being, according to him, 13.5 cm and 5.3 cm in total height. If my identification is correct, I like to suppose these differences as variations dependant on growth. I agree, on the other hand, with KÜKENTHAL as to the assignment of this species to the Umbellate group, as the terminal twigs compose large hemispherical umbels.

19. *Dendronephthya pellucida* n. sp.

(Fig. 19; Plate X, Fig. 16)

A gigantic colony of umbellate branchings, about 35 cm in total height and 25 cm in maximum expanse. It has a very plump and flaccid trunk, about 12 cm in maximum diameter, and at the base bears numerous long stolons entangled with debris and sands.

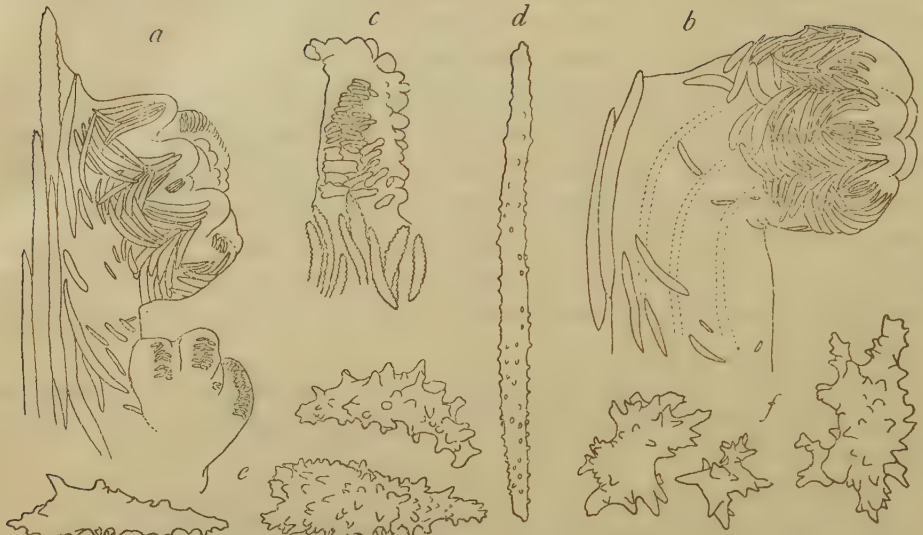


Fig. 19. *Dendronephthya pellucida* n. sp. a, b, Polyp; c, arrangement of spicules in tentacle; d, spindle from cortex of twigs; e, spicules from cortex of basal stalk; f, large spicules from canal-walls. (a, b $\times 50$, c-f $\times 70$)

For the first 3 cm in height the stem is bare; then there arise a series of small foliate branches (about 50 in number) around the stem, and then at a height of 8 cm and 12 cm from the base, strong main branches, about 5-6 cm broad, are borne. A little higher up, two large branches are given off and then the main stem forks terminally. The polyparium is formed by further ramification of these main branches; thus the outline of polyparium is not uniform and not flattened laterally, but the umbels of terminal twigs form each a large hemispherical upper surface.

Polyps compactly massed in groups of 10-20 at top of short-stalked terminal twigs located on surface of the colony. Polyp head, about 0.5 mm long and 0.7 mm wide, round cup like, making a right or slightly obtuse angle with a short plump stalk. Anthocodial armature consists of 6-8 pairs of spindles of subequal length, about 0.26-0.33 mm long, which fit closely together in eight points. Between points usually occur 2 or 3 pairs of smaller intermediate spicules. Tentacles long, with elongate or oval rodlike red spicules, about 0.046-0.056 mm long, in bilinear rows. S.B. consists of 3-5 very weak, less-spinose spicules, usually not projecting beyond polyp head; in certain cases one may be as long as 1.3 mm and slightly project. Polyp stalk, usually shorter than 1 mm and 0.4-0.6 mm wide, very plump, pellucid and almost nude. Anthocodial formula:

II=(6-8)p+0Cr+weak S.B.+(2-3)M

Cortex of terminal twigs covered very sparingly with slender, red or brick-red, spindles with sparsely-set low warts, up to 1 mm long, which become larger on smaller branches up to 3 mm long. Cortex of larger branches and main stem are, however, wholly nude. In short basal stalk, there are many of red or white, cortical spicules, consisting of dumb-bells, pseudo-clubs and star-shaped forms covered with strong thorns, about 0.1-0.4 mm long. In canal-walls also many smaller, colorless, translucent, flat rodlets with bi- or trifurcate ends, about 0.09-0.14 mm long and 0.001 mm wide occur. There are also larger, very thorny spindles and derivatives, though relatively few in number; 0.35×0.12 mm, 0.37×0.14 mm, 0.5×0.2 mm.

Coloring. Polyp armature and twigs brick-red in upper part of the colony, while dark red in lower branches. Polyps themselves yellowish. Cortex of main stem and branches brownish yellow, while stalk cortex blood-red.

Locality. Tanabe Bay, 15 m.

Remarks. In the mode of branching and the anthocodial armature this specimen comes very near to *D. dendrophyta* (WRIGHT & STUDER) recorded from China Sea and Philippines, but the spiculation of the cortex and canal-walls and also its gigantic size are so different and distinctive that I am compelled to establish a new species.

20. *Dendronephthya habereri* KÜKENTHAL

(Fig. 20; Plate X, Fig. 17)

Dendronephthya habereri, KÜKENTHAL (1905, p. 638), THOMSON & DEAN (1931, p. 121).

A compact and very stiff colony of the Umbellate type. Polyparium considerably flattened in a long oval contour; in one specimen, it is about 6.4 cm high, 9 cm wide and 3.5 cm in thickness. Stalk very short, completely hidden under lowest foliaceous branches of polyparium. Base broadly flattened, encrusting rock or stones.

Polyp head small, rounded, about 0.4-0.5 mm long and 0.6-0.8 mm wide, standing at a right angle with short polyp stalk, up to 0.8 mm long. Uppermost points somewhat larger, a little projecting, but usually incurved over the mouth. Tentacles and spaces between points heavily armoured with tiny rodlike spicules. Anthocodial formula:

III=(5-6)p+0Cr+strong S.B.+many M

Cortex of branches and upper part of stalk thickly covered with very

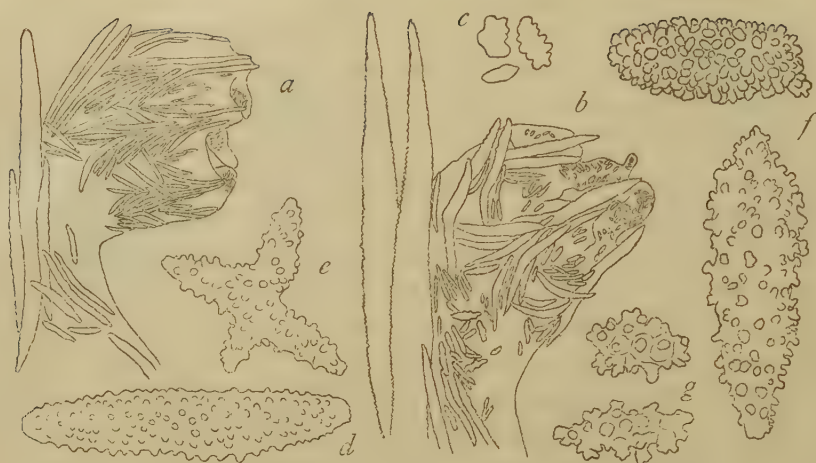


Fig. 20. *Dendronephthya habereri* KÜKTH. a, b, Polyp; c, tentacle spicules; d, spindle from upper cortex; e, quadriradiate form from basal cortex; f, g, spicules from canal-walls. (a, b, d, e×35, f, g×55, c×150)

large, plump, strongly warted spindles up to 3.5mm long and 0.35 mm wide, usually bluntly ended. On basal flattened part of stalk are shorter, very plump spindles, triradiates, quadriradiates with strong rounded warts, up to 1 mm long and 0.18 mm wide. Canal-walls thickly filled with similar spicules.

Coloring. All spicules of polyps and branches purple-red, stem bright red to white, while basal expanded portion of stalk dark or bright red.

Localities. Tanabe Bay and Kusimoto. Common.

Remarks. As KÜKENTHAL and THOMSON & DEAN point out, there is considerable variability in this species. Another specimen, which is 10 cm high, 7.5 cm wide and 4.2 cm thick, shows the same anthocodial armature, but it differs in coloration of polyps and in spiculation of lower cortex. In this, the polyps and their spicules are yellow, while the spicules of S.B. and polyp stalk are chocolate red. The spicules of lower cortex are all much more robust, bluntly ended, warty spindles, up to 3.5 mm long and 1 mm wide, which lead to almost globular very knobby forms, but not multiradiate forms.

21. *Dendronephthya dofleini* KÜKENTHAL

(Fig. 21; Plate XI, Fig. 28)

Dendronephthya dofleini, KÜKENTHAL (1905, p. 662), THOMSON & DEAN (1931, p. 131).

Two small specimens obtained at different stations agree well with this

species. One complete specimen is 3.2 cm high, of which about one-half belongs to sterile stalk bearing stolons at base. In another one, the polyparium is almost globular in outline, somewhat flattened laterally, and about 2.8 cm long and 3 cm wide, the stalk being missing.

Polyp head, about 0.5 mm long and 0.6 mm wide, standing at a right or obtuse angle with short stalk, less than 1 mm (in foliaceous branches, however, up to 2 mm long). Anthocodial formula:

$$\text{III}=5\text{ p}+0\text{ Cr}+\text{strong S.B.}+2\text{ M}$$

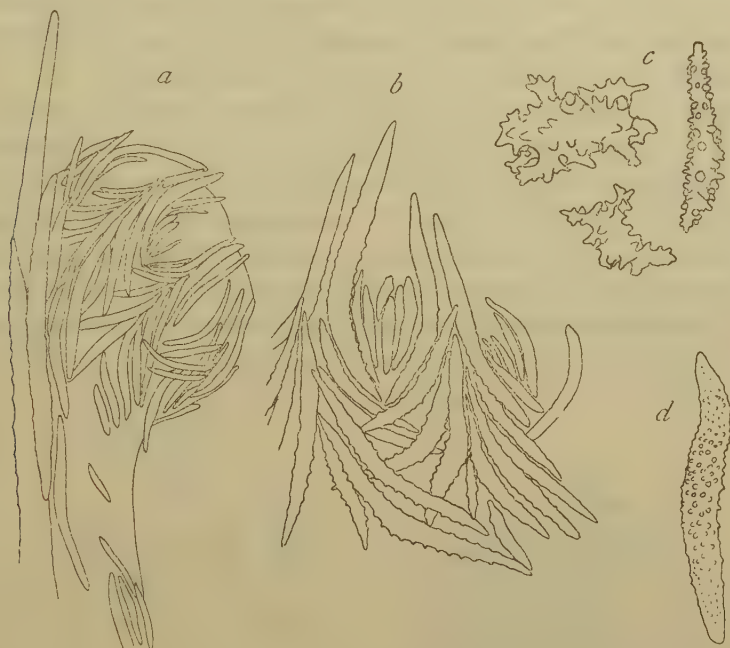


Fig. 21. *Dendronephthya dofleini* KÜKTH. a, Polyp; b, part of anthocodial armature; c, spicules from lower cortex; d, spindle from canal walls. ($d \times 35$, a, c $\times 55$, b $\times 65$)

On upper cortex are long curved spindles up to 2.5 mm long; in foliaceous branches, however, they attain a length of about 5 mm. On lower cortex are short spindles with rounded warts about 0.35×0.07 mm, mingled with many strong warty triradiates, quadriradiates and stellate forms, mostly about 0.35 mm across. Canal walls rather thick and sparsely filled with warty spindles with almost smooth ends, about 1-1.5 mm long.

Coloring. Wholly yellowish white or glossy white, but examination with a lens reveals that a few red colored spicules are mingled in some places, though not so confined to polyps as shown in previous descriptions.

Localities. Seto and off Minabe, 100-200 m.

Previously recorded from Hongkong, Malay Peninsula and Kei Islands.

22. *Dendronephthya pulchella* n. sp.

(Fig. 22; Plate XI, Fig. 30)

A small beautiful colony with loosely disposed umbels. Polyparium consisting of 2 main branches somewhat flattened in an elongate-oval contour, about 4 cm long and 3.2 cm wide. Stalk slender, limp, about 2 cm long and 8 mm wide at its mutilated base. Surface of polyparium practically even, covered with umbels of approximately the same length (about 4-5 mm); heads of lower umbels with radially shooting groups of polyps are slightly flattened making a narrow flat disc, but not forming any ordinary foliaceous collar around stem.

Polyps in divergent groups of 2-5 at top or margins of umbels. Polyp head cuplike, about 0.58-0.65 mm high and 0.76 mm wide, making almost a right angle with slender stalk up to 1 mm long and 0.4 mm wide at base. Anthocodial armature in eight double rows of almost smooth, slender spicules, 5-7 in a row. Outermost pair markedly longer, about 0.26-0.5 mm long, a little projecting beyond head and almost twice as long as lower ones (0.12-0.26 mm long). A few intermediate spicules occur between points. Tentacles with 2

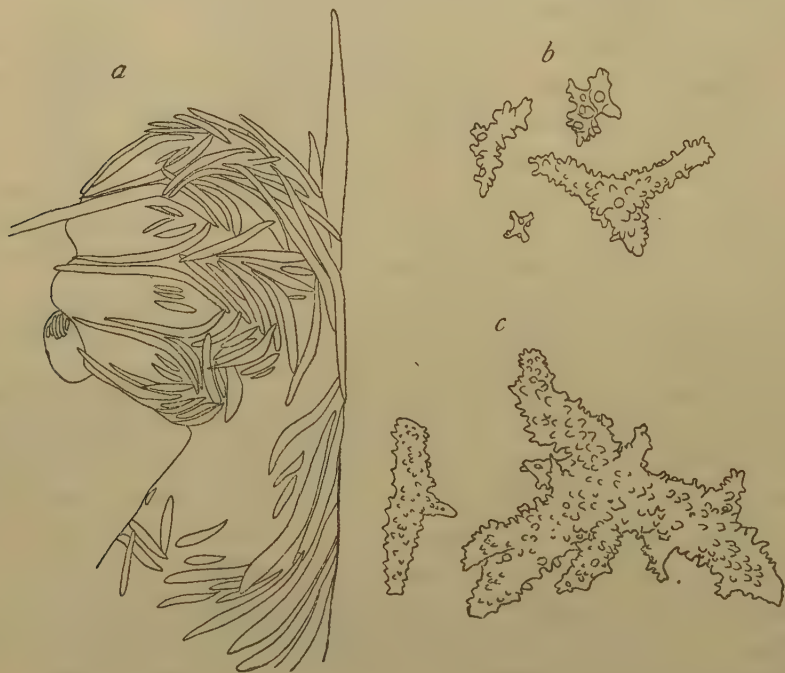


Fig. 22. *Dendronephthya pulchella* n. sp. a, Polyp; b, spicules from lower cortex; c, spicules from canal-walls of stalk. (c×35, a, b×55)

distinct rows of transparent, flat rods, about 0.028–0.047 mm long, densely disposed transversely. S.B. fairly developed and usually only one spicule projects freely for up to 1 mm long; all are finely warted with a smooth projecting tip and about as long as 3 mm. Anthocodial formula:

$$\text{III}=1\text{P}+(4-6)\text{p}+0\text{Cr}+\text{strong S.B.}+(1-2)\text{M}$$

Upper cortex covered with pinkish white slender spindles, up to 3 mm long, arranged longitudinally. On lower cortex are numerous, smaller, pink or white, curved warty spindles, triradiates, multiradiates and stellate forms, about 0.09–0.3 mm long, together with larger curved spindles up to 0.88 mm long and 0.1 mm wide, occurring sparingly. Canal-walls of upper branches free from spicules, but those of stalk filled with large, pink or white, plump spindles, triradiates and multiradiates with prominent warts, measuring 0.88×0.23 mm, 1.76×0.24 mm.

Coloring. Polyps and their spicules ivory white, S.B. and twigs pink, stalk and branches pinkish white.

Locality. Tanabe Bay, 10 m.

Remarks. The umbellate branching of polyparium in no very uniform outline points to KÜKENTHAL's *spinulosa* group. In general appearance it comes near to *D. hyalina* known from Pescadores and Malayan waters, but differs distinctly in many respects, especially as regards the anthocodial and cortical spiculation and the coloration.

23. *Dendronephthya disciformis* KÜKENTHAL

(Fig. 23; Plate X, Fig. 18)

Dendronephthya disciformis, KÜKENTHAL (1905, p. 636), SHANN (1912, p. 519), THOMSON & DEAN (1931, p. 136).

A compact, disc-like, umbellate colony with very short stalk, about 5.5 cm long, 7 cm wide and 3.3 cm thick. Polyparium composed of a large number of shortly divergent, plump branches of which terminal umbels are superficially in close contact, forming a uniform outline, but laterally flattened. Lowest two large side branches and two small median branches form a complete collar around the base of stem and completely hide the stalk, so that it is only visible from undersides.

Polyps in compact groups of 4–20. Polyp head about 0.5 mm long and 0.65 mm wide, making an obtuse angle with polyp stalk not over 1 mm long. Anthocodial armature very irregular and variable, but usually consists of eight double rows, a strongly projecting uppermost one and 3–4 obliquely or

almost transversely arranged spindles in each row. In addition there are usually 2 pairs of small intermediate spicules between uppermost points. Tentacle spicules sparse, colorless, about 0.1 mm long. S.B. strongly developed, largest spicules as long as 3 mm projecting for up to 1 mm long beyond polyp head, with a smooth free tip. Anthocodial formula:

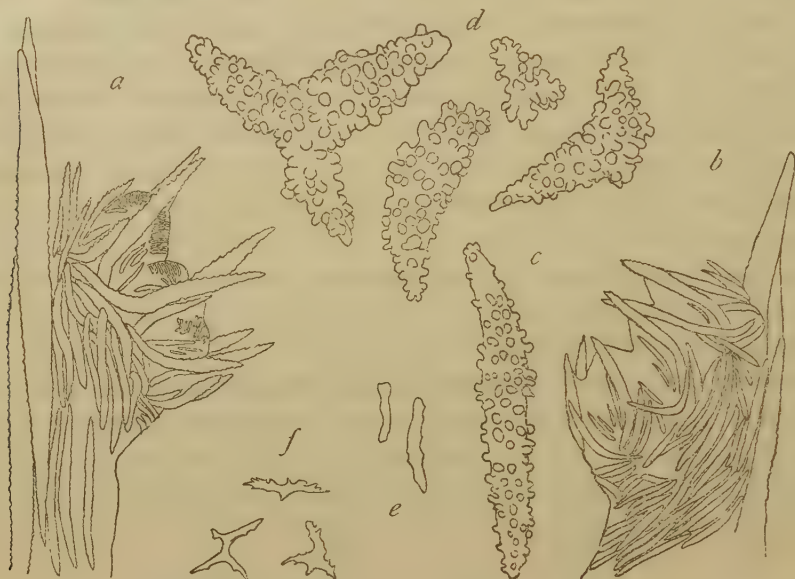


Fig. 23. *Dendronephthya disciformis* KÜKTH. a, b, Polyp; c, spindle from upper cortex; d, spicules from basal cortex; e, tentacle spicules; f, antler-like bodies from canal-walls. (a-c×35, d, f×55, e×130).

IV=1P+(3-4)p+0Cr+very strong S.B.+2M

Cortex of branches and twigs densely covered with pink to reddish white, warty spindles up to 3 mm long and 0.18 mm wide; they are arranged longitudinally in terminal branches and twigs, while transversely in main branches and stem. On basal cortex are mostly shorter curved spindles, triradiates, quadri-radiates and stellate spicules with prominent rounded warts, mostly 0.05-0.7 mm long. Canal-walls contain numerous spindle-like or antler-like toothed flat bodies, about 0.07-0.2 mm long.

Coloring. Spicules of polyps, S.B. and terminal twigs dark red, branch cortex pink to reddish white, stalk greyish brown. Polyps themselves yellowish brown and tentacles white.

Locality. Tanabe Bay, 5 m. Very common.

Previously recorded from China Sea. Singapore and Malay Archipelago.

Remarks. Besides there are in my collection many specimens, washed

up on beaches or obtained by lobster-nets from adjacent localities, which I would refer to this species. They are generally more dark red in umbels and below these brilliant orange on cortex of twigs, then paler downwards to white cortex of branches and stem. They are all markedly flattened in one plane, and the spiculation generally corresponds with the preceding.

In a specimen, about 7.5 cm high and 8 cm wide, the lower point spicules are sometimes transversely arranged, giving somewhat of an impression of a vague 'pseudo-crown'. The tentacles are very long up to 0.5 mm long and provided with dark red spicules about 0.05-0.1 mm long in 2 close-set rows. Intermediate spicules are more numerous and S.B. spicules are more strongly developed, and its projecting largest one extends up to 4 mm long and 0.2 mm wide and differently colored at tip and base (Fig. 23a).

In another abnormal specimen, the polyparium is decidedly not flattened in one plane, but irregular in outline, showing somewhat the glomerate fashion of branching. And also the coloration of the lowest foliaceous branches differs from that of the upper umbellate branches, the former branches only being yellowish white in contrast with the surrounding chocolate-red coloration. This abnormal outgrowth, as well as the abnormal mottled coloration, would seem to depend on the condition of attachment. The other characters are, however, identical with those of the typical form of *D. disciformis*.

24. *Dendronephthya densa* KÜKENTHAL

(Fig. 24; Plate X, Fig. 22)

A small fragment without stalk closely resembles *D. pumilio* KÜKENTHAL of *spinosa*-group, but it may be referable to *D. densa* of the same group in its tentacular spiculation. Polyparium roughly globular, not flattened laterally, about 2.7 cm long and 3.7 cm wide, and with red polyps covered on rounded outer surface of branches, clustered together.

Polyp head somewhat flattened laterally, about 0.6 mm long and 0.8 mm wide, making an obtuse angle with polyp stalk up to 2 mm long. Anthocodial armature in eight points of 5-6 steeply converging pairs, of which uppermost pair larger up to 0.7 mm long and projects far out of head, especially in laterals. 1 or 2 paired short, slender intermediate spicules are found at a triangular wide space between points. Tentacles long, thickly armed with red, elongate rods about 0.07-0.1 mm long. S.B. consists of some slender, finely warted spindles, of which one or two predominate, up to 4 mm long, and a



Fig. 24. *Dendronephthya densa*
KÜKTH. Polyp. ($\times 35$)

little project beyond polyp head. Polyp stalk slender, densely armoured with long spindles lying obliquely. All polyp spicules slender, densely covered with minute warts throughout. Anthocodial formula :

$$IV=1P+(4-5)p+0Cr+\text{medium S.B.}+(1-2)M$$

Cortex of branches densely covered with similar spindles up to 2 mm long. Canal-walls contain only antler-like flat bodies up to 0.26 mm long.

Locality. Off Minabe, 100-200 m. March 1944.
S. SAKAGUCHI *leg.*

Previously recorded from Sagami Bay, 150 m.

Remarks. KÜKENTHAL (1906, p. 51) describes the tentacle spicules of the type specimen of *D. densa* as colorless. In my specimen, however, it is distinctly red-colored. Such difference in spicular coloration seems to be of no taxonomic importance

as shown in examples of the preceding *D. habereri* and *D. disciformis*.

25. *Dendronephthya acaulis* KÜKENTHAL

(Figs. 25; Plate X, Figs. 20, 21)

Dendronephthya acaulis, KÜKENTHAL (1906, p. 40), NUTTING (1923, p. 15).

Six small specimens with the same structure, differing from one another in coloration only, can be referred to this species.

	Polyparium			Stalk			Lowest branches	Color scheme
A	4.0 cm	1 3.5 cm	w	2.5 cm	1 1.0 cm	w	not foliaceous	peach-red
B	4.0	„ 5.0	„	2.0	„ 1.5	„	foliaceous	orange
C	3.0	„ 4.0	„	2.5	„ 1.2	„	„	peach-red
D	3.0	„ 3.0	„	1.0	„ 0.7	„	„	pale red
E	3.0	„ 3.0	„	1.8	„ 1.0	„	slightly foliaceous	yellow
F	2.0	„ 2.5	„	missing			not foliaceous	„

These specimens may be referred to KÜKENTHAL's *spinosa*-group of the Umbellatae, although KÜKENTHAL suggests its affinity with *D. mollis* of the Divaricatae. Umbels combined together in form of an almost spherical mass. Stalk cylindrical, about half as long as polyparium and at base with numerous stolons. Lowest branches usually foliaceous. Polyps, about 0.7 mm long and 0.7-

0.8 mm wide, standing at an obtuse angle on slender stalk up to 2 mm long. Anthocodial armature in eight double rows, 4-5 pairs in a row, of which uppermost pair up to 0.8 mm long highly projecting beyond polyp head. Inter-



Fig. 25. *Dendronephthya acaulis* KÜKTH. a, Polyp; b, tentacle spicules; c, spicules from canal-walls; d, spicules from lower cortex. (a, c, d $\times 35$, b $\times 150$)

mediate spicules usually only one, often up to 4 in number. Tentacle spicules colorless, flat rods with jagged edges up to 0.1 mm long, arranged in 2 rows. S.B. weakly developed, composed of 2 or 3 long spindles up to 3.5 mm long, mostly shorter, with slightly projecting tip. Ventral side of polyp stalk irregularly disposed with long spindles. Upper cortex with colorless warty spindles up to 2 mm long. Lower cortex and canal-walls with much smaller warty spindles, triradiates and irregular forms, about 0.08-0.4 mm long. Anthocodial formula :

$$IV=1P+(3-4)p+0Cr+weak\ S.B.+(\frac{1}{2}-2)M$$

Localities. Tanabe Bay, 5-30 m; off Minabe, 100-200 m.

Previously recorded from Japan only (Uraga Strait, 151 m, Ose zaki, 57 fms, near Oki Is., 59 fms.).

26. *Dendronephthya castanea* n. sp.

(Fig. 26; Plate X, Fig. 19)

Three brilliant colonies of umbellate type taken from different localities were examined. One of them (Plate X, Fig. 19) taken at Kii-ôshima, which is

selected as the holotype, is only about 5 cm in total height, of which one-half belongs to sterile stalk. Its polyparium very rigid, spiny in appearance, almost circular in outline, and slightly flattened laterally, about 3.5 cm by 4.5 cm. Lowest branches broadly foliaceous, directed downwards and almost hide the upper half of stalk. Polyps at terminal twigs in form of umbels densely crowded together to form an even outer surface, so that the bare stem and branches are completely hidden. Stalk rather robust, cylindrical and its lower half bearing a few stolons at base is only visible.

A large colony (paratype) from Tanabe Bay shows, however, a different branching type of growth, much like the Clomeratae group. Its polyparium shows an expanse of about 11×9 cm and a height of about 7 cm. The very short sterile stalk divides into about six main branches, about 4-6 cm long, which in turn give off numerous secondary branches forming rounded masses of umbels on all sides. Lowest umbels of branches around the sterile stalk are transversely broadened and fairly foliaceous. Thus the growth is rather bushy, so that the contour of polyparium is not uniform. Yet the spiculation and coloration do not differ from the holotype.

Polyps densely massed in groups of 5 to 10 at ends of short robust twigs. Polyp head about 0.53 mm long and 0.67 mm wide, more or less compressed laterally, standing at an obtuse angle with slender polyp stalk, about 0.7 mm long and 0.35 mm wide at base. Anthocodial armature in eight double rows, 2 to 5 in a row, of which one of the uppermost pair hockey-club-like, up to 0.7-0.8 mm long, extending prominently, and the other shorter, at most 0.3 mm long. All these spicules covered sparingly with upward-directing thorns and sharply ended. No crown spicules. Between points 1-3 short curved intermediate spicules occur. Tentacles thickly filled with curved, elongate or oblong, small spicules up to 0.1 mm long and 0.035 mm wide, not in rows; in a long-time deposited specimen (holotype) the spicule is colorless, while in fresh material from Nada and Tanabe Bay (paratypes) it is chocolate-red in color. S.B. strongly developed, one or two spicules up to 3.5 mm long projecting for 1-1.5 mm long beyond polyp head; these spicules are densely covered with conical or blunt warts except at the free tip where it is smooth. Ventral side of polyp stalk sparsely armed with slender spindles, mostly 0.45 mm long. Anthocodial formula:

$$IV=1P+(1-4)p+0Cr+very\ strong\ S.B.+(1-1)M$$

On cortex of stem and branches are strongly warted, yellow or white spindles, about 1-1.5 mm long. On cortex of stalk are yellowish white to colorless, smaller spindles, about 0.7-1.3 mm long which lead to club-like and irregular-shaped almost globular forms with strong warts. Canal-walls thickly filled with antler-like tiny flat bodies and curved spindles, about 1.3×0.23 mm,

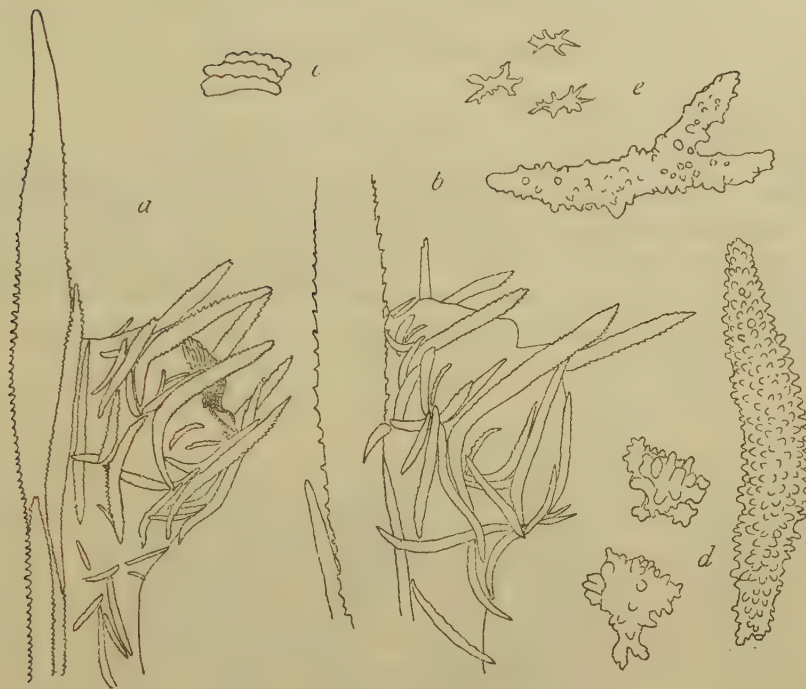


Fig. 26. *Dendroneplithya castanea* n. sp. a, b, Polyp (a, sp. from Nada; b, sp. from Osima); c, tentacle spicules; d, spicules from lower cortex; e, triradiate and antler-like spicules from canal-walls. (a, b $\times 35$, c $\times 55$, d $\times 130$)

and triradiates, about 0.7×0.1 mm, are found (in paratype, spindles attain to about 5×0.7 mm in size).

Coloring. Terminal branches and polyp stalk orange, but polyp head much paler. Point and S.B. spicules glossy white. Stem and stalk dirty yellowish or white. Tentacle spicules, when alive, chocolate-red.

Localities. (Holotype) Kii-ôshima. A young specimen. 1944. S. SAKAGUCHI leg. (Paratype) Nada, Hidaka-gun. A fragment. December 12, 1950. T. YAMAMOTO leg.; Sisô-zima, Tanabe Bay. A large specimen. April 19, 1952. T. YAMAMOTO leg.

Remarks. In the uniform grouping of umbels, forming an almost spherical but somewhat flattened polyparium with a short stalk, the type specimen may be referred to KÜENTHAL's *dendrophyta*-group. However, the growth type of the paratype from Tanabe Bay does not agree with it. The polyp spiculation appears like that of *D. pectinata* (HOLM) and *D. mollis* (HOLM), both belonging to different groups. It does not, however, agree with any of formerly described species within these groups.

27. *Dendronephthya pectinata* (HOLM)

(Fig. 27; Plate XI, Figs. 31-33)

Spongodes pectinata, HOLM (1895, p. 47).*Dendronephthya pectinata*, KÜKENTHAL (1905, p. 671; 1906, p. 54).

Three handsome specimens referred to this species are examined. They are all similar in general spiculation and coloration. The largest one (Plate XI, Fig. 33) measures about 24 cm in total height, of which 14 cm belongs to the polyparium; its stalk is 10 cm long and 2-2.5 cm wide at base. General coloration is white, tinged with whitish yellow in some polyps. Anthocodial formula:



Fig. 27. *Dendronephthya pectinata*
(HOLM). Polyp. ($\times 35$)

$$IV=1P+3p+0Cr+\text{medium S.B.}+0M$$

Canal-walls of upper stem and branches contain, as KÜKENTHAL describes, antler-like flat bodies about 0.1 mm long alone, but those of sterile stalk have none.

Localities. Tanabe Bay, 10-30 m; off Minabe, 100-200 m.

Previously recorded from Japan only (Hirado Strait, Misaki).

28. *Dendronephthya longicaulis* KÜKENTHAL

(Fig. 28; Plate XI, Fig. 34)

Dendronephthya longicaulis, KÜKENTHAL (1905, p. 633), THOMSON & DEAN (1931, p. 141).

A gigantic colony, about 36 cm in total height, consists of a very long, flexible stalk (27 cm long) gradually tapering upwards and an irregularly and loosely branched polyparium (9 cm long) somewhat flattened. Sterile stalk bears no stolon at base and its whole surface from top to base, oddly enough on one side only, is thickly encrusted with an athecate hydropolyp, *Hydrocoryne miurensis* STECHOW, as in KÜKENTHAL's original type. Two lowest branches of polyparium are foliaceous to form a collar directing downwards. General color of the colony is brownish yellow, though anthocodial spicules are all colorless and transparent.

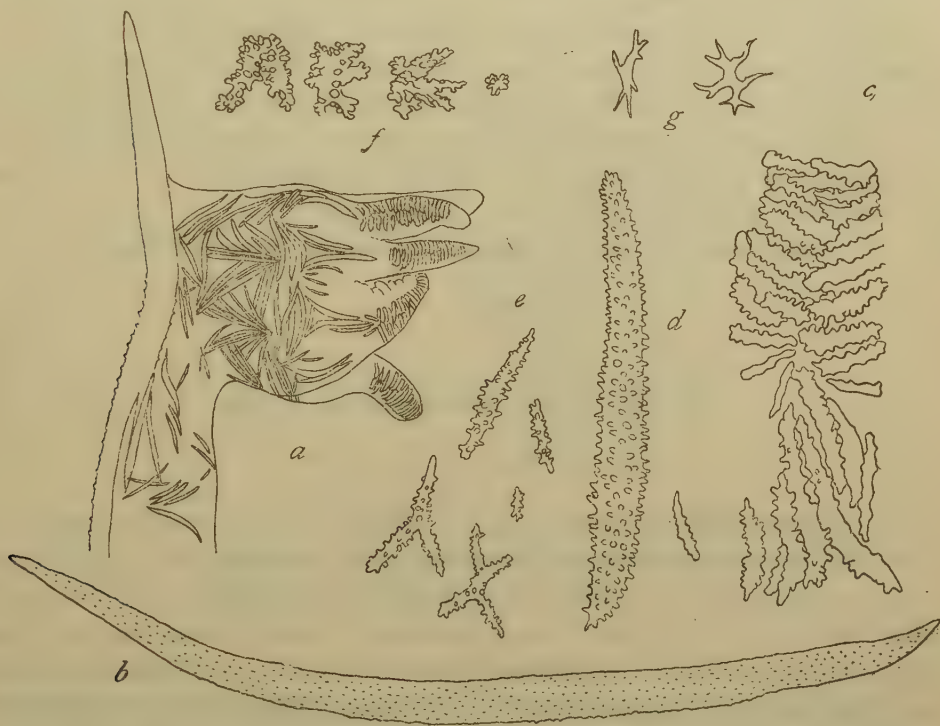


Fig. 28. *Dendronephthya longicaulis* KÜKTH. *a*, Polyp; *b*, spindle of S.B.; *c*, base of tentacle, showing the arrangement of tentacle and point spicules; *d*, large spindle from upper cortex; *e*, small spindles and derivatives from upper cortex; *f*, stellate spicules from stalk cortex; *g*, antler-like flat bodies from canal-walls of twigs. (*a*, *b* $\times 35$, *d-f* $\times 50$, *c*, *g* $\times 150$)

Polyp head about 0.7-0.9 mm long and 0.7-1 mm wide, standing at a right to obtuse angle with slender, 1 mm long, stalk. Ventral side of polyp stalk usually almost bare. Anthocodial armature in eight widely spaced points of one pair, below which 2-5 horizontals and 4-10 converging pairs of slender spindles; the number of these crown spicules much exceeds that described by

former authors. Tentacles with flat rodlike toothed spicules closely set in 2 rows. S.B. weakly developed and scarcely projecting, but often may extend for 0.3–0.8 mm long beyond polyp head; its spicules up to 3.5 mm long and very finely warted, though almost smooth toward the ends. Anthocodial formula:

$$VI=1P+(7-15)Cr+weak\ S.B.+(1-3)M$$

On cortex of branches and twigs two types of spicules may be found.

- (1) Larger spindles; about 0.88×0.08 mm, 1.76×0.1 mm, 2.2×0.17 mm.
- (2) Smaller spindles, triradiates and quadriradiates; about 0.1×0.01 mm, 0.3×0.015 mm, 0.6×0.058 mm.

They are all loosely disposed, somewhat longitudinally in twigs and transversely in main branches. On lower cortex they are all displaced by stellate forms, about 0.1–0.23 mm long. Canal-walls of twigs and branches contain very sparsely antler-like flat bodies, about 0.07 mm long, while they are quite absent in stalk, as is also the case with *D. pectinata*.

Locality. Off Minabe, 100–200 m. March 1950.

Previously recorded from Nagasaki, Japan and Sumbawa Island.

29. *Dendronephtya gloriosa* n. sp.

(Fig. 29; Plate X, Figs. 23, 24)

A brilliant orange-colored colony of umbellate type, with a long oval, somewhat flattened polyparium (8.5 cm long, 6 cm wide and 3.4 cm thick) and a short cylindrical stalk (about 2.5 cm long and 1.5 cm wide). A continuous collar formed of two lowest broad foliaceous branches encircling the stem distinctly separates the polyparium from the stalk. Above this the main stem divides into two large branches of unequal length, which give off loosely on all sides many terminal branches of variable length in form of small umbels. Therefore, the umbels do not combine in larger hemispherical masses. The specimen should therefore be referred to KÜKENTHAL's *spinulosa* group of the Umbellatae, approaching nearest to *D. lutea*. But the spiculation does not agree with the latter, so as to justify in establishing a new species for this specimen.

Polyps in compact groups of 5–7 at ends of short robust twigs. Polyp head large rounded, about 0.6–0.7 mm long and 0.8–1 mm wide, standing at a very obtuse angle with short, plump stalk up to 1 mm long. Anthocodial armature consists of eight points, each one with 2 large, stout, hockey-club-like spindles, sometimes appended with a smaller one at base; one of the



Fig. 29. *Dendronephthya gloriosa* n. sp. a, Polyp; b, spindle from upper cortex; c, spicules from lower cortex; d, flat antlers from canal walls of branches; e, multiradiates from canal walls of stalk.
(a×35, c×55, b, d, e×70)

points larger than the other, and attains up to 0.7 mm long and 0.05 mm wide. Below these about 3 horizontal rows of crown spicules are closely disposed. Between points widely apart there occur 1 to 4 much smaller intermediates basally. Tentacles with pale orange flat rods, up to 0.08 mm long, closely disposed in 2 rows. S.B. strongly developed, one or two of largest spicules up to 4 mm long project beyond polyp head for over 1 mm long, with smooth free tip. Ventral side of polyp stalk densely disposed with large spindles similar to those of S.B., continuing into crown spicules of head. All polyp spicules markedly spinose. Anthocodial formula:

$$\text{VI}=1\text{P}+3\text{Cr}+\text{very strong S.B.}+(1-2)\text{M}$$

Upper cortex densely packed with warty spindles up to 3.5 mm long and 0.5 mm wide, mostly lying transversely. In cortex of stalk are more plump,

smaller spindles densely covered with large rounded warts, up to 1.5 mm long, leading to much smaller roundish thorny forms. Canal-walls contain antler-like flat bodies up to 0.1 mm long which grow larger downwards in form of multiradiate forms up to 0.45 mm long with scattered low warts.

Coloring. All anthocodial and terminal cortical spicules bright orange, stem and branch cortex pale orange, stalk whitish, while polyps themselves pale yellow.

Locality. Tanabe Bay. May 1942.

Remarks. There is also a fragment (Plate X, Fig. 23) collected from Kii-ôshima which I would refer to the same species. The general feature of the spiculation and coloration conforms with the preceding description, but the polyps are mostly much larger (0.6-0.8 mm long and 1.1-1.3 mm wide) and paler in coloration, and the projecting tip of S.B. spicules is colored dark red. The spiculation and coloration of this form somewhat resemble those of *D. punicea* (STUDER) of the Glomeratae known from Japan. But the growth form is obviously of the Umbellate type, as described above.

REFERENCES

- GRAY, J. E. 1862. Description of some new species of *Spongodes* and a new allied genus (*Morchellana*) in the collection of the British Museum. Proc. Zool. Soc. London, 1862.
- 1839. Notes on the fleshy Alcyonoid corals. Ann. Mag. Nat. Hist., Ser. 4, vol. 3.
- HICKSON, S. J. 1903. The Alcyonaria of the Maldives. Part I. Fauna and Geogr. Maldives & Laccadive Arch., vol. 2.
- & I. L. HILES 1900. The Stolonifera and Alcyonacea collected by Dr. WILLEY etc. WILLEY's Zool. Results, Part 4.
- HOLM, O. 1895. Beiträge zur Kenntniss der Alcyonidengattung *Spmgodes* LESS. Zool. Jahrb., Abt. Syst., Bd. 8.
- KÜKENTHAL, W. 1896. Alcyonaceen von Ternate. Abh. Senckenb. naturf. Ges. Frankfurt, Bd. 23.
- 1905. Versuch einer Revision der Alcyonarien. II. Die Familie der Nephthyiden. 2. Teil. Zool. Jahrb., Abt. Syst., Bd. 21.
- 1906. Japanische Alcyonaceen. Abh. K. Bayer. Akad. Wiss. II. Suppl.-Bd. 1, Abt. 1.
- 1911. Alcyonarien von den Aru- und Kei-Inseln nach den Sammlungen von Dr. H. MERTON. Abh. Senckenb. naturf. Ges. Frankfurt, Bd. 33, Ht. 4.
- MACFADYEN, L. M. I. 1936. Alcyonaria. Great Barr. Reef Exped. 1928-29 Sci. Rep., vol. 5, no. 2.
- MAY, W. 1900. Beiträge zur Systematik und Chorologie der Alcyonaceen. Jena. Z. Naturw., Bd. 33.
- NUTTING, C. C. 1923. Descriptions of the Alcyonaria collected by the U. S. Fisheries Steamer "Albatross" mainly in Japanese waters during 1906. Proc. U. S. Nat. Mus., vol. 43.
- PÜTTER, A. 1900. Alcyonaceen des Breslauer Museums. Zool. Jahrb., Abt. Syst., Bd. 13.
- RIDLEY, S. O. 1882. Contributions to the knowledge of the Alcyonaria, with descriptions of new species from the Indian Ocean and the Bay of Bengal. Ann. Mag. Nat. Hist., Ser. 5, vol. 9.

- ROXAS, H. A. 1933. Philippine Alcyonaria. II. The families Alcyoniidae and Nephthyidae. Philipp. J. Sci., vol. 50, no. 4.
- SHANN, E. W. 1912. Observations on some Alcyonaria from Singapore etc. Proc. Zool. Soc. London, 1912.
- STERRIFFS, W. R. 1922. Evolution within the genus *Dendronephthya* (*Spongodes*) etc. Proc. Zool. Soc. London, 1922.
- STIMPSON, W. 1856. Descriptions of some of the new marine Invertebrata from the Chinese and Japanese Seas. Proc. Acad. Nat. Sci. Philadelphia, vol. 7.
- STUDER, Th. 1888. On some new species of the genus *Spongodes* LESS. from the Philippine Islands and the Japanese Seas. Ann. Mag. Nat. Hist., Ser. 6, vol. 1.
- THOMSON, J. A. & L. M. I. DEAN 1931. The Alcyonacea of the Siboga Expedition. Siboga-Expeditie, Mon. 13d.
- & W. D. HENDERSON 1906. The marine fauna of Zanzibar and British East Africa etc. Alcyonaria. Proc. Zool. Soc. London, 1906, vol. 1.
- & D. MACKINNON 1910. Alcyonarians collected on the Percy Sladen Trust Expedition. Part II. Trans. Linn. Soc. (Zool.) London, vol. 13.
- & J. M. MCQUEEN 1908. Reports on the marine biology of the Sundanese Red Sea. VIII. The Alcyonarians. J. Linn. Soc. (Zool.) London, vol. 31.
- & J. J. SIMPSON 1909. An account of the Alcyonarians collected by the Royal Indian Marine Survey Ship "Investigator" in the Indian Ocean. Part II. The Alcyonarians of the littoral area.
- VERRILL, A. E. 1864. List of the polyps and corals sent by the Museum of Comparative Zoölogy to other institutions in exchange, with annotations. Bull. Mus. Comp. Zoöl., vol. 1.
- 1865. Synopsis of corals and polyps of the North Pacific Exploring Expedition etc. Part II. Proc. Essex Inst., vol. 4, no. 10.
- WRIGHT, E. P. & Th. STUDER 1889. Alcyonaria. Challenger Report, vol. 31.

EXPLANATION OF PLATE IX

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| Fig. 1. | <i>Dendronephthya nipponica</i> n. sp. (Holotype) | ×1/2. |
| 2. | <i>D. nipponica</i> n. sp., from below. (Holotype) | ×1/2. |
| 3. | <i>D. gigantea</i> (VERRILL). | ×1/2. |
| 4. | <i>D. gigantea</i> (VERRILL), young compact colony. | ×1/2. |
| 5. | <i>D. tuberculata</i> n. sp. (Holotype) | ×1/2. |
| 6. | <i>D. aculeata</i> KÜKENTHAL. | ×4/5. |
| 7. | <i>D. aurea</i> n. sp. (Holotype) | ×1/3. |
| 8. | <i>D. japonica</i> KÜKENTHAL. | ×1/2. |
| 9. | <i>D. palmata</i> n. sp. (Holotype) | ×1/2. |
| 10. | <i>D. furcata</i> n. sp. (Holotype) | ×1/2. |

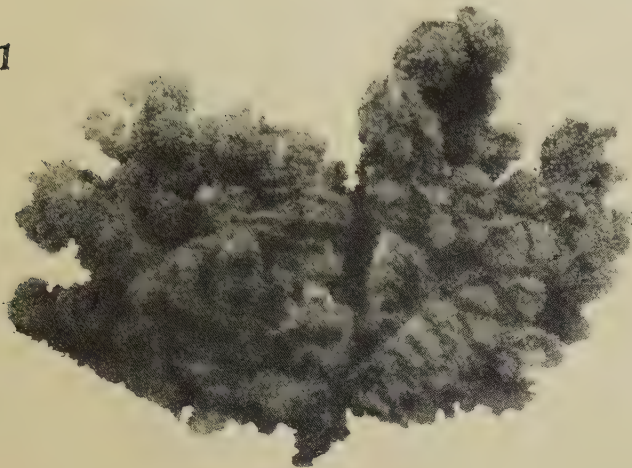
EXPLANATION OF PLATE X

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| Fig. 11. | <i>Dendronephthya palaoensis</i> n. sp. (Holotype) | ×1/2. |
| 12. | <i>D. golgotha</i> n. sp. (Holotype) | ×3/5. |
| 13. | <i>D. cervicornis</i> (WRIGHT & STUDER). | ×3/5. |
| 14. | <i>D. spinulosa</i> (GRAY). | ×1/2. |
| 15. | <i>D. dromidicola</i> n. sp. (Holotype) | ×1/2. |
| 16. | <i>D. pellucida</i> n. sp. (Holotype) | ×1/5. |
| 17. | <i>D. habereri</i> KÜKENTHAL. | ×1/2. |
| 18. | <i>D. disciformis</i> KÜKENTHAL. | ×4/5. |
| 19. | <i>D. castanea</i> n. sp. (Holotype) | ×4/5. |
| 20. | <i>D. acaulis</i> KÜKENTHAL. (Sp. C) | ×4/5. |
| 21. | <i>D. acaulis</i> KÜKENTHAL. (Sp. B) | ×4/5. |
| 22. | <i>D. densa</i> KÜKENTHAL, fragment. | ×4/5. |
| 23. | <i>D. gloriosa</i> n. sp., fragment from Kii-ôshima. | ×4/5. |
| 24. | <i>D. gloriosa</i> n. sp. (Holotype) | ×3/4. |

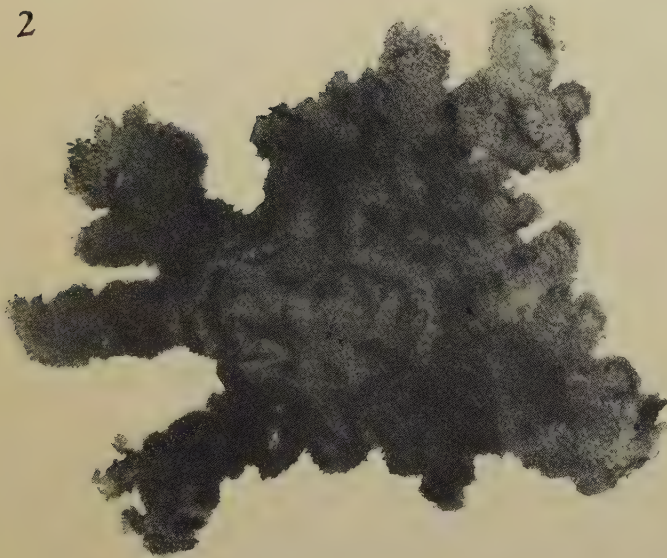
EXPLANATION OF PLATE XI

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| Fig. 25. | <i>Dendronephthya decussa'ospinosa</i> n. sp. (Holotype) | ×1/2. |
| 26. | <i>D. alba</i> n. sp. (Holotype) | ×1/2. |
| 27. | <i>D. filigrana</i> KÜKENTHAL. | ×1/2. |
| 28. | <i>D. dofleini</i> KÜKENTHAL, fragment. | ×2/3. |
| 29. | <i>D. divaricata</i> (GRAY). | ×2/3. |
| 30. | <i>D. pulchella</i> n. sp. (Holotype) | ×2/3. |
| 31. | <i>D. pectinata</i> (HOLM), young colony. | ×2/3. |
| 32. | <i>D. pectinata</i> (HOLM) from Tanabe Bay. | ×1/2. |
| 33. | <i>D. pectinata</i> (HOLM), upper part of large colony. | ×1/2. |
| 34. | <i>D. longicaulis</i> KÜKENTHAL, upper part of large colony. | ×1/2. |

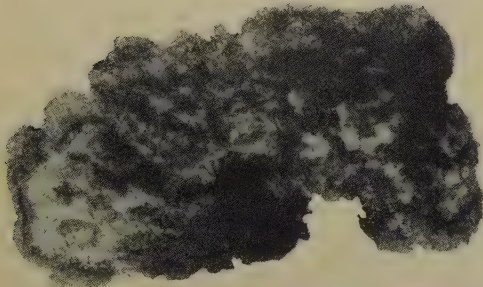
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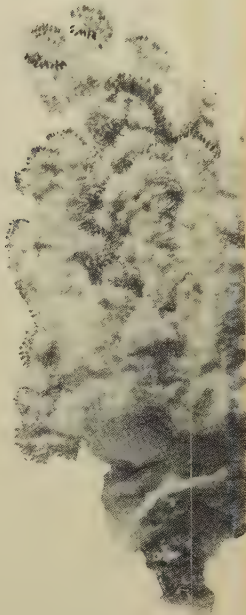
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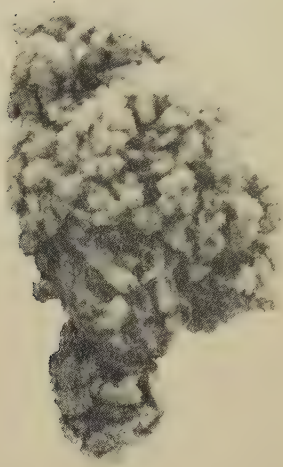
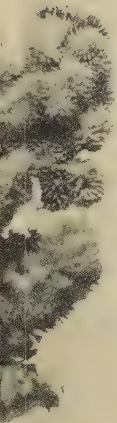
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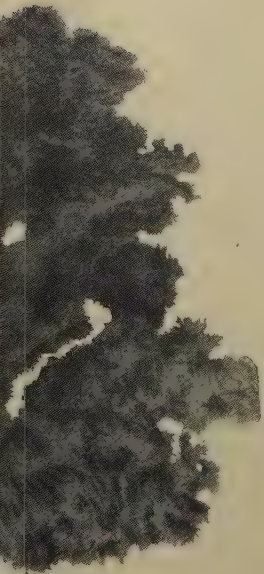
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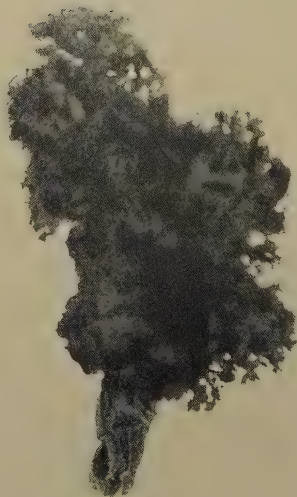
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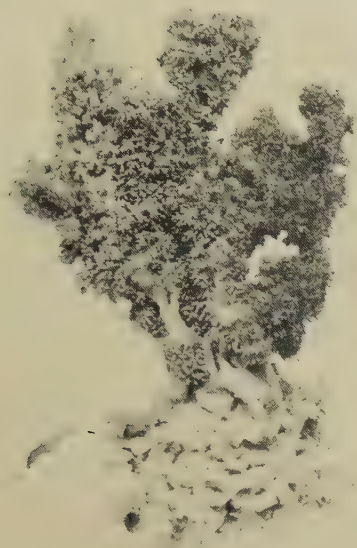
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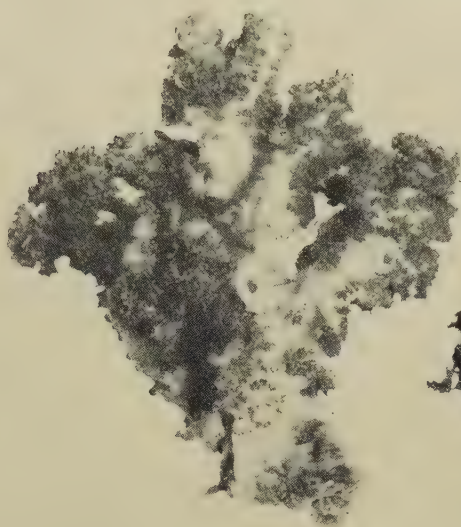
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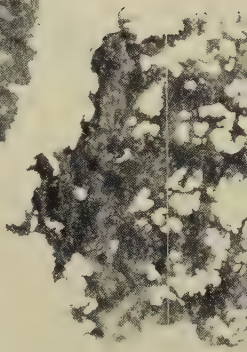
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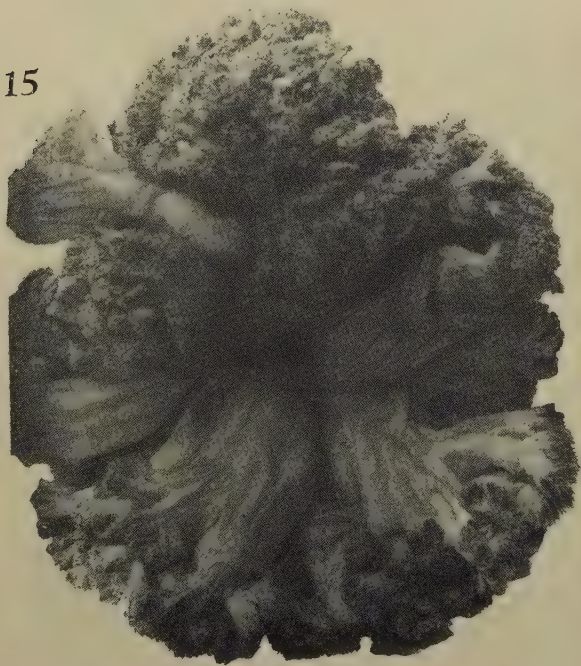
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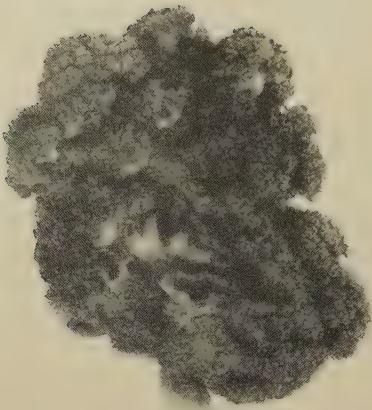


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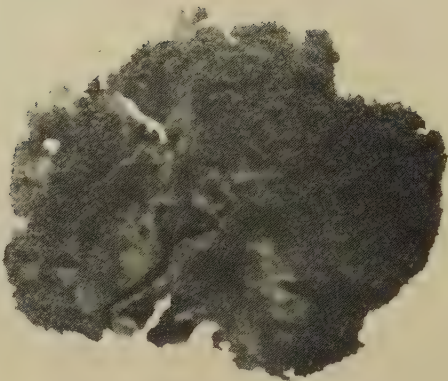


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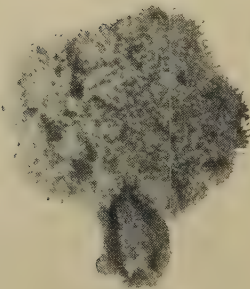
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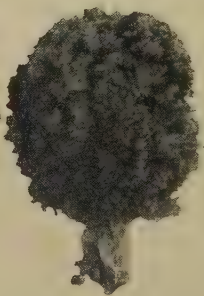
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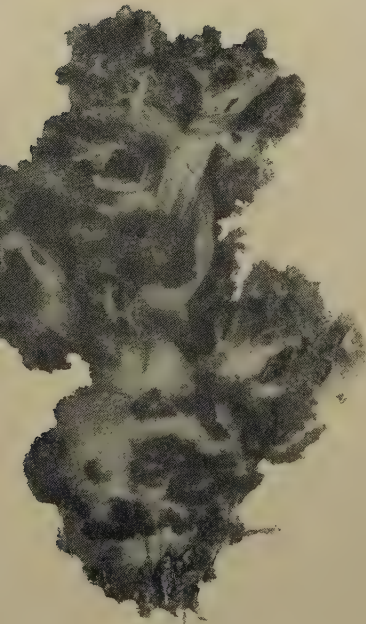
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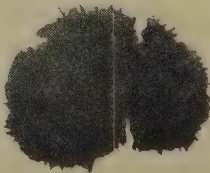
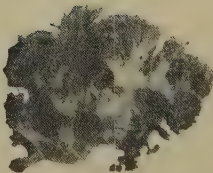
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STUDIES ON THE DAILY RHYTHMIC ACTIVITY OF THE
STARFISH, *ASTROPECTEN POLYACANTHUS* MÜLLER
ET TROSCHER, AND THE ACCOMPANIED
PHYSIOLOGICAL RHYTHMS^{1,2}

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With 9 Text-figures

I. INTRODUCTION

A considerable number of works have hitherto been published on the periodic activity of animals (refer to MORI, 1948; KLEITMAN, 1950). These knowledges show that the rhythmic phenomenon is one of the important basic phenomena prevailing in the world of living organisms, and it is this periodic phenomenon by which the complex ecosystem is maintained in harmonized condition. It is obvious, in this field, that thorough researches are desirable which give some consistent explanations to various knowledges concerning the external manifestations of behaviors, internal physiological conditions and environmental states. Nevertheless, we have now only little knowledges about these unifying researches. The senior author have been elaborated several works on this line since 1935 using some freshwater snails (MORI, 1946, 1948), a sea-pen (MORI, 1950) and a loach (MORI, 1951). This report is one of the works on this line, dealing with the starfish, *Astropecten polyacanthus* MÜLLER et TROSCHER, as the material. This animal inhabits on the shallow sandy bottom near the Seto Marine Biological Laboratory, and we studied their daily rhythmic behaviors during 1947 to 1949 at this Laboratory.

We wish to acknowledge our indebtedness to Professor Denzaburo MIYADI for his kindness in reading the original manuscript; to Dr. Huzio UENOMI, Dr.

-
- 1) Contributions from the Seto Marine Biological Laboratory, No. 183.
 - 2) This research was aided by the Scientific Research Expenditure of the Department of Education.

2. Activities become more and more vigorous as they become hungry, but the vigor seems to attain its maximum at the 3rd day and thereafter remains constant.

III. RELATIONS BETWEEN ACTIVITY AND ENVIRONMENTAL FACTORS

Major factors seem to be light and food. Thermic factor seems to play no significant rôle so long as the daily cycle is concerned.

1. Light

This is the most important factor by which the periodicity is controlled. They never move about when the intensity of light is above 2000 Lux, and move most actively below 100 Lux. Also they do rarely move during night under complete darkness.

a) Activities under constant darkness

They maintain their rhythmic activities 2 or 3 days under constant darkness. During this period the rhythmicity become gradually irregular and after 3 days it becomes obscure. The experiments were repeated twice, during July 14 to 19 of 1947 and July 15 to 22 of 1949. The results obtained at the latter case are shown in Figure 2. It must be noted in this case that the

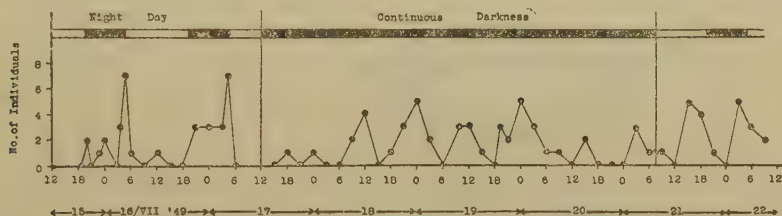


Fig. 2. Persisting rhythm under constant darkness.

peaks of activity during the experimental dark periods were seen at 12 and 24 o'clock, whereas at the former case, in spite of the procedures taken during the experiment were the same as those of the latter case, the peaks were seen at the ordinary hours, namely, at dusk and at dawn of natural daytime. The cause of this inconsistency is not clear, but it may be said that the mechanisms of this persistency of rhythmic activity should not be searched for in the exogenous affairs but in the endogenous one.

b) Diurnal changes in photic reactions

During our observation of the activity at night by using the illumination of pocket-lamp, we noticed that the reaction of animals to light was considerably different through the course of night, i.e., the tendency to come out from beneath the sand, stimulated by sudden illumination, grew stronger as the time of sunrise approached. It seemed to be clear that the sensibility to light

was changed periodically, which was responsible, at least partly, for the occurrence of daily rhythmic activity of the starfish. To test this phenomenon more precisely, we attempted the experiment as below. Forty individuals collected on July 13, 1949, were placed in an aquarium under diffused daylight and the ordinary activity was previously observed. From July 16, the room was darkened once a day for an hour at different times from day to day. The numbers of animals moving about on the sand were counted at every 1.5-3 hours during the whole course of the experiment, and especially during darkened periods countings were made at every 15 minutes. The procedures and the results of the experiment are shown in Table 1.

Considering about the photic reaction indices and the χ^2 values, it can be said that the sensibility of the starfish to sudden decrease of illumination intensity during daytime is most raised at dawn, and then falls markedly, and

Table 1. Numbers of animals moving on the sand before and after darkening the environment.

Date		16/VII, '49	17	19	20	18
Time when the environment was darkened		6	9	12	15	18
No. of individuals moving on the sand	Just before darkening (A)	2	2	2	6	0
	15 minutes after darkening (B)	18	8	8	18	6
"Photic reaction index" B/A		9	4	4	3	.6+
χ^2 values,* showing the significance of the difference between A and B		15.000	2.857	2.857	7.202	4.504

* χ^2 value at some time was calculated, using 2 by 2 table, as follows:

	Number of individuals		Total
	Remaining still beneath the sand	Moving on the sand	
Just before darkening	a_1	a_2	T_a
15 minutes after darkening	b_1	b_2	T_b
Total	T_1	T_2	T

$$\chi^2 = \frac{(a_1 b_2 - a_2 b_1 \pm T/2)^2 \times T}{T_a \times T_b \times T_1 \times T_2}$$

again in the afternoon towards dusk it rises to a fair degree. This change in photic sensibility may undoubtedly be playing some important rôle in the performance of the daily rhythmic activity of the starfish. The experiment with the change of sensibility to light during nighttime has not been performed, but it is now under consideration.

2. Food

As is shown in Figure 1, food as an environmental factor exerts great influence upon the activity. But its rôle is anyway restricted within the range of the modifier to "intensity" or "quantity" of activity, and is, therefore, different from the light which is the real controlling factor of the rhythm. In order to see clearly the changes of activity during hunger, the next experiment using actogram was attempted. The disc of the starfish was bound by

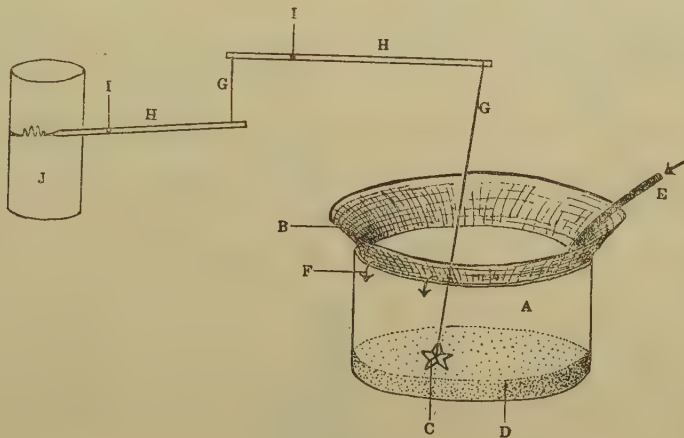


Fig. 3. Arrangement to record automatically the activity of the starfish. A: glass vessel in which the animal is reared (diameter 30 cm, height 15 cm). B: wire gauze. C: starfish. D: sand. E: tube for inlet of water. F: overflow of water. G: thread. H: lever. I: fulcrum. J: recording drum rotating once a day.

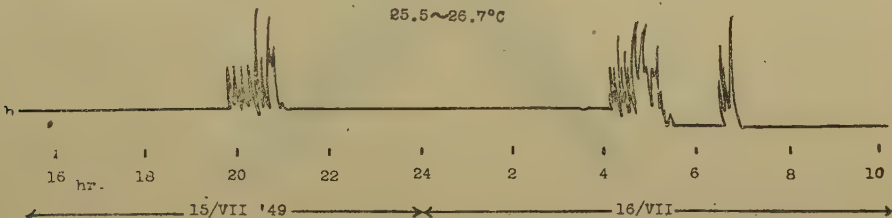


Fig. 4. An instance of the actographic representation of activity.
b: basal line.

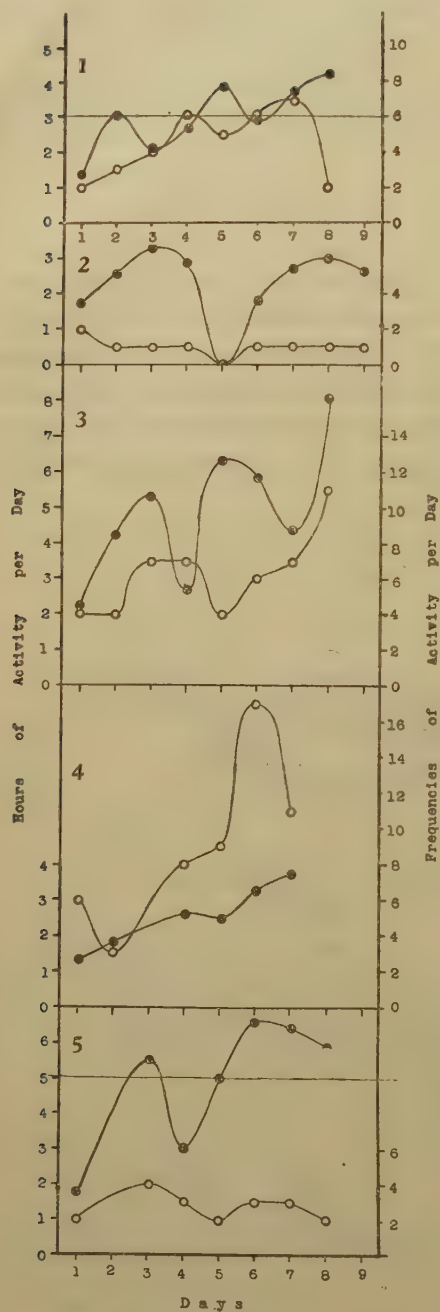


Fig. 5. Changes in hours and frequencies of activity per day during hunger. 1 to 5 show the results of 5 individuals respectively.

a fine wire, tightly but carefully not to injure the animal body, and this wire was connected with the describing lever by a thread. Figure 3 shows general arrangements.

The starfishes were sufficiently fed at the first day of the experiment and thereafter were kept without supplying any foods. Records of 5 individuals during consecutive 7 to 9 days (from July 13 to 22, 1949) were obtained. An instance of the record is shown in Figure 4.

Generally speaking, both hours and frequencies of activity per day increase as hungry condition proceeds. These trends could be clearly represented by performing adequate operations to the records. Namely, when the inclination of the activity curve to the basal line was above 45° and its amplitude exceeded 5 mm in height within an hour, it was regarded as the animal was in the active state. The hours of activity per day were obtained by summing up the periods of this condition through a day and the frequencies of activity per day were obtained by counting the numbers of the continuous phase of activity. The results obtained are shown in Figure 5.

It is concluded from this experiment that the hours of activity of 4 individuals out of 5 increase gradually, in a broad way, with the lapse of time and after a week the quantities become 3 to 4 times of the initial condition. It is conspicuous that there

are some periodic fluctuations, the cycle of which is about 3 days. The increases in the frequencies of activity per day are rather less prominent when compared with the increases of the hours of activity, but at 3 individuals out of 5 the general trend of increment may be recognizable, and in this case also some fluctuations of large periods can be seen.

3. Temperature and other Factors

The temperature and other environmental factors, so long as their daily periodicities concern, seem to have no effect upon the rhythmic activity.

IV. SOME PHYSIOLOGICAL ANALYSES OF THE RHYTHMIC ACTIVITY

1. Photoreceptors

Whether the eye spots are photoreceptors regulating the rhythmic activity or not? To ascertain this point, all of the eye spots of 10 individuals were severed and the activities of these individuals were examined. But we could not find out any influences, and they exhibited routine rhythmic activities.

2. Rhythmic activities of severed arms and amputated individuals

How are the autonomic movements of each arm and the coordinations of the body as a whole in the exhibition of the rhythmic activity? Two

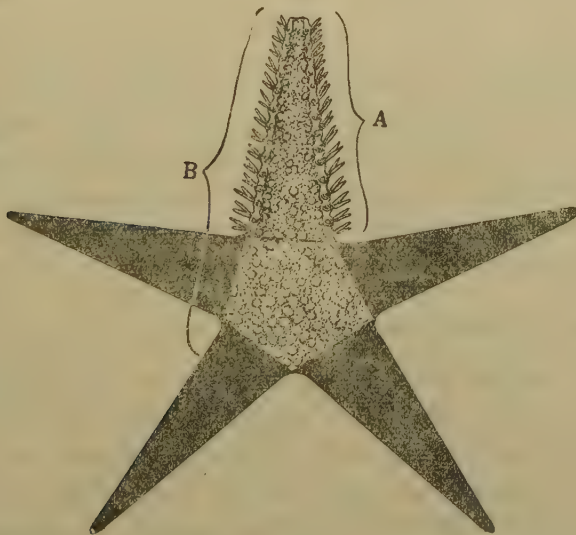


Fig. 6. Severed arm (A) and amputated individual (an arm+disc, B). Eye spot of the arm is severed.

series of experiments were performed in order to clarify these questions, the one by using 40 arms without eye spots severed from the discs as is shown in Figure 6 A, and the other by using 10 individuals, each with only one arm without eye spot as is shown in Figure 6 B.

i. Results with amputated individuals.

Although the rhythmic activity was not vigorous, tendency to move about at dawn could be clearly recognized. They rest quietly at dusk. Except righting and burrowing movements, which were slightly disharmonized, general features of movement were the same as seen in normal individuals.

ii. Results with severed arms.

Results obtained are shown in Table 2.

Table 2. Rhythmic activities of severed arms without eye spots. Operations were performed for 40 arms at 9.30 on July 15, '49.

Date		15/VII	16	17	18
No. of individuals	Time (o'clock)	21	0 3 6 9 12 15 18 21	0 3 6 9 12 15 18 21	0 3 6 9
	Buried in the sand	32	36 36 26 29 27 25 26 32	32 32 29 30 30 32 32 32	32 30 27 29
	Resting on the sand	7	4 4 9 11 12 12 14 8	8 8 9 9 10 8 8 8	10 10 12 11
	Moving on the sand	1	0 0 5 0 1 3 0 0	0 0 2 1 0 0 0 0	0 0 1 0

Severed arms repeat gentle bending motion and seldom go further than 1-2 cm in one of the successive movements. They burrow into the sand from the top of the arm. General modes of the rhythmic activity resemble to those of amputated individuals, and move about, although sluggishly, only at dawn. This trend coincides with the results of observation in normal individuals in which the maximum activity occurred at dawn.

3. Daily changes of oxygen consumption

Changes of oxygen consumption may be one of the best indicators of the general physiological conditions of animal body. From this standpoint we attempted the experiment to show whether there were any daily changes in the quantities of oxygen consumed per unit time or not, and if any, what kinds of correlations existed between these changes in oxygen consumption and the external manifestations of activity. General arrangements for experiment are shown in Figure 7.

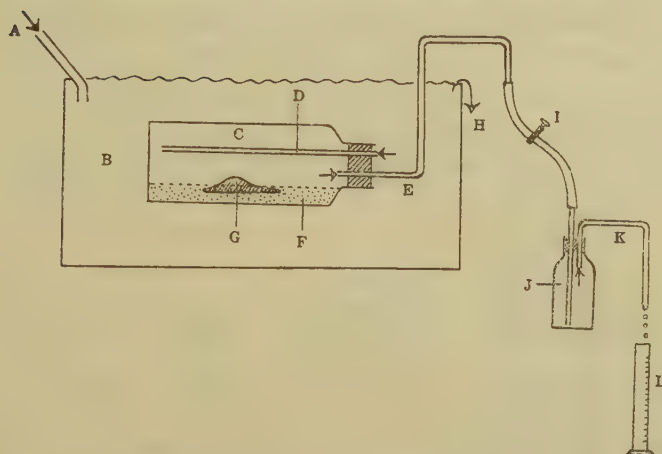


Fig. 7. Arrangements to measure the quantities of oxygen consumed. A: inflow of sea water. B: large vessel for reservoir of water. C: experimental vessel. D: glass tube for inflow of water to C. E: glass tube for outflow of water from C to J. F: sand. G: starfish. H: overflow of water. I: pinch cock. J: bottle for sampling the water (about 100 cc.) K: glass tube for outflow of water from J. L: messycylinder.

One or three starfishes were placed in the experimental vessel (C), the pinch cock of which (I) were opened sufficiently so that the water in the experimental vessel was thoroughly circulated. The rate of oxygen consumption of the starfishes was measured at every 3 hours throughout the day. Just before the time of the measurement, the pinch cock was so screwed that the quantity of water flowing through the experimental vessel containing one animal was made to be about 10 cc per minute. The rate of the flow was determined by the messycylinder L. After an hour the sampling bottle was

Table 3. Data for the experiment of oxygen consumption

No. of the experimental vessel	No. of individuals contained in the vessel	Weight (g)	Volume of water in the experimental vessel (cc)	Volume of sand in the experimental vessel (cc)
1	3	10.6 10.7 15.1	1460	690
2	1	9.1	320	175
3	1	7.9	320	180

taken off and the pinch cock was loosened so as to let the water run as before. The oxygen contents of water were determined by the Winkler's method. The numbers and the weights of animals used in the experiment, and the amounts of water and sand in the experimental vessels are shown in Table 3. The experiments were performed during July 15 to 16 and July 17 to 18 of 1949. The results obtained at the former case are shown in Figure 8.

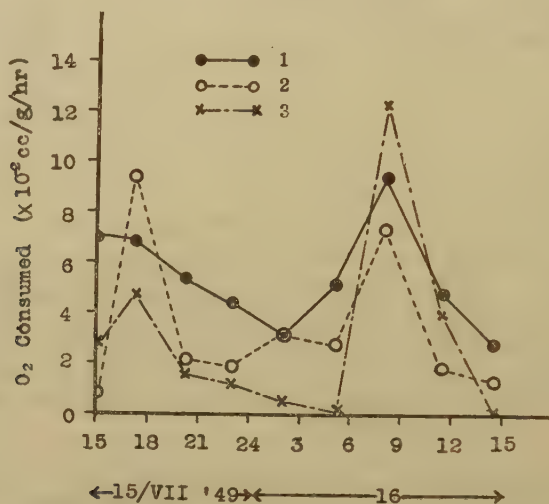


Fig. 8. Daily changes in the rate of oxygen consumption of the starfishes. 1, 2, and 3 indicate the numbers of the experimental vessels. Values shown in the curve 1 are those obtained by treating 3 individuals as a group.

It is clear from this figure that two peaks can be recognized, of which the peak at dawn is higher. These facts coincide exactly with the features of ordinary rhythmic activity.

4. Daily changes of hydrogen ion concentration in body fluids

As well as the rate of oxygen consumption, this factor may also be one of the general indices of the physiological states. The methods employed were as follows: Taking out the animal from the aquarium in which it was reared for several days before the experiment, the water attached on the surface of the body was absorbed by using blotting paper. Then, cutting off the end of one arm, the body fluids flowing out from there were collected in a test tube and the hydrogen ion concentration was determined by using the indicator method. Through the course of treatments, we took care to treat the animal quietly and quickly as possible. The experiments were executed

at every 3 hours throughout the consecutive 2 days, during July 19 to 21, 1949, using 5 individuals each time. Figure 9 shows the results obtained.

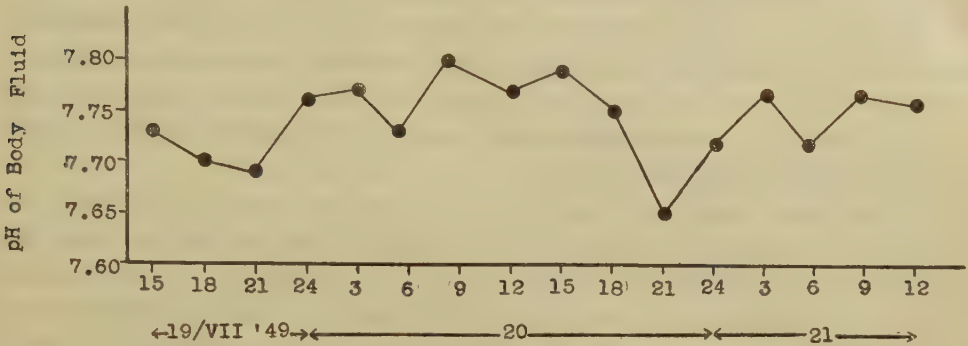


Fig. 9. Daily changes of the hydrogen ion concentrations of body fluids. Mean values of 5 individuals at every time are represented.

It may be concluded from this figure that the body fluid becomes more acidic twice a day, at dawn and at dusk, namely, when the starfishes move most actively. There is a tendency to exhibit higher pH values during daytime than during night, and the reason for this phenomenon is not clear.

V. CONSIDERATIONS

1. The senior author has long been emphasizing that the nature of the rhythmic activity can not be clarified ultimately unless the thorough knowledges about the actions of the environmental factors and the internal physiological conditions of animal body are obtained (MORI, 1947, 1948a, 1948b, 1950). To his opinion, the normal rhythmic activity is maintained under the dual controls, the one by the periodic changes of environmental factors and the other by the rhythmic changes of internal physiological conditions which have more or less intrinsic, hereditary characters. The rhythm of activity can be modified or put into disorder by disturbing balances of the forces from environments and from internal conditions. The degrees of influences from these two sources on the exhibition of the rhythmic activity are different in different animals. Considerable amounts of works have hitherto been done concerning the effects of the changes of environmental factors. The modes of changes of environmental factors tried by many investigators may be sorted into two main categories, namely, maintaining the factors in constant conditions or changing the cyclic phases of factors (reversing the alternative phases, or lengthening or shortening the periods). By these experiments it has been found that some animals are affected seriously by the changes of environmental factors and

others are scarcely affected having conspicuous tendencies to persist the original rhythmic activities. In this way, it seemed to be the best way to pay efforts in finding the correlations between the external manifestations of rhythmic behaviors and internal physiological rhythms. Nevertheless, we can scarcely find this sort of research at present, and especially there is no conclusive report except with the sea-pen, *Cavernularia obesa*, whose daily rhythmic behavior was forced to modify by altering artificially the internal physiological conditions (MORI, 1945, 1950).

The present report is the work along this line, and at the first step general features of the daily rhythmic activity of the starfish are observed, and at the second step degrees of persistency of the rhythm, in other word, degrees of independency of the rhythm to the environments, are investigated, and at the third step some physiological changes that are considered as having intimate relations with the behaviors are researched.

2. The rhythmic activity of the starfish is principally controlled by the changes of light, as in most other animals studied. The temperature and other physico chemical factors of environments seemed to have no important influences on the activity so long as their daily marches concerned. This is also the ordinary circumstances at many animals living in water.

3. The establishment of the intrinsic physiological rhythms is relatively weak, so that the rhythmic behavior is persisted only during 2 or 3 days after the animal had been placed in constant dark conditions.

4. The states of hunger affect considerably the intensities of activity, i.e., they move more and more vigorously as they become hungry. However, it must be noted here that the times of a day when they search for foods are generally restricted to dawn or dusk, so that the rôle of this factor is quite a modifying one.

5. After all, it may be concluded that the crepuscular activity of the starfish is regulated and controlled by the change of light, the liveliness of which is greatly influenced by the states of hunger. Although the physiological conditions show rhythmic alterations with the changes of activity, the establishment of the internal physiological rhythms is rather incomplete, and the animal can only persist its daily rhythmic behavior during 2 or 3 days under constant darkness.

VI. SUMMARY

1. The observations of the daily rhythmic activity of the starfish, *Astropecten polyacanthus*, which is the common inhabitant on the shallow sandy bottom and the physiological analyses of the behavior were performed at the

Seto Marine Biological Laboratory, Wakayama Prefecture, during 1947 to 1949.

2. They showed conspicuous daily rhythmic behavior, moving on the sand most actively at dawn and then less actively at dusk, and generally stayed quietly beneath the sand during midday and midnight.

3. The controlling environmental factor was the light, and other physico-chemical factors seemed to have scarcely been concerned.

4. The food as an environmental factor played the important rôle on the vigorousness of the activity. As more and more they are hungered, so the activity become livelier. But this factor was the modifier against the intensity of rhythmic activity, and not the real controller that alters the phases of rhythm.

5. Eye spot was not concerned with the rhythmic activity.

6. Not only the amputated individual with only one arm, but also the severed single arm, showed tendency to move daily rhythmically. Generally speaking, active movements in these cases were observed at dawn.

7. The amounts of oxygen consumed per unit time showed clear daily periodic changes. Two peaks were observed, the one at dawn and the other at dusk, the former was the greater.

8. The hydrogen ion concentrations of body fluids also revealed the daily periodic changes. Two peaks were observed at dawn and at dusk, the latter was the larger (contrary to the case of the oxygen consumption).

LITERATURE

- KLEITMAN, N. 1949: Biological rhythms and cycles. *Physiological Rev.*, 29, 1-30.
- MORI, S. 1945: Daily rhythmic activity of the sea-pen, *Cavernularia obesa* Valenciennes. VIII. Endogenous daily rhythmic activity. *Reports on the Physiology and Ecology, Kyôto University*, No. 19.
- 1946: Daily rhythmic activities of the Japanese freshwater snails. (1). *Ibid.*, No. 60.
- 1947: A concept on mechanisms of the endogenous daily rhythmic activity. *Mem. Coll. Sci., Univ. Kyôto, Ser. B*, 19, 1-4.
- 1948a: Harmony between behavior rhythm and environmental rhythm. *Ibid.*, Ser. B, 19, 71-74.
- 1948b: Rhythmic activities of animals. *Hoppô Syuppan Sya*.
- 1948c: Daily rhythmic activities of two Japanese freshwater snails. (2). *Seibutu*, 8, 204-209.
- 1950: Daily rhythmic activity of the sea-pen *Cavernularia obesa* Valenciennes. XII. Conclusions—Problems on relations among environments, behaviors and internal physiological conditions. *Physiol. Ecol.*, 4, 12-20.
- 1951: Relation between activity and glycogen contents of the Japanese loach. *Mem. Coll. Sci., Univ. Kyôto, Ser. B*, 20, 1-6.

OBSERVATIONS ON THE ALGAE GROWING ON
THE POND TORTOISES, WITH SPECIAL REFERENCE TO
BASICLADIA CRASSA HOFFMANN & TILDEN*

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With 41 Text-figures

Introduction

On one day of December, 1951, a vial containing some fresh-water algae was sent up to the writer by Dr. T. TOKIOKA of the Seto Marine Biological Laboratory. The algae were gathered from the shells of living tortoises, bred in a porcelain basin at the quadrangle of Mr. S. KITAJIMA in the City of Tanabe, Wakayama Prefecture. Examining the material microscopically, the writer found that the algal mass consisted for the most part of a species of *Basicladia*, a filamentous green alga of *Cladophoraceae*. Several species of other algal genera were also found growing epiphytically on its filaments, and some minute forms, moreover, found associated with them. In the course of the study of the species of *Basicladia*, the writer noticed the material was not sufficient for the detailed investigation. Thereupon he took an opportunity of visiting the place in March, 1952, and collected more complete samples.

Algae growing on living animals have attracted considerable attention of phycologists on account of their peculiar habitat, and a good number of publications on the subject has been appeared in the world. But being little known for the algae growing on the shells of pond tortoises in Japan, the writer wishes to report a preliminary note on this occasion. He intends to publish more satisfactory results in future after ample collections are made from various parts of our country. The present study, based upon the small collection, may be somewhat imperfect. This paper, however, dealing principally with *Basicladia* is the first particular information of the sort in Japan.

The writer desires to extend his thanks and acknowledgments to Dr.

* Contributions from the Seto Marine Biological Laboratory, No. 184.

T. TOKIOKA, who has been kindly enough to give him the opportunity for this study and publication. The writer owes to Mr. S. KITAJIMA for the material.

In Japan, an old tortoise with its shell overgrown with water plants is commonly called "Mino-game." In China it is known as "Lü-mao-kwei," which means the "green haired tortoise." In Europe and America it is also well-known as "moss-back turtle." Of course, the so called "hairs" or "moss" are filaments of some green algae growing on the carapace of the animal. Where there is a rich growth of green filaments, the animal presents an attractive appearance. Japanese as well as Chinese consider such a tortoise as an auspicious animal, and it has often been treated in classics. The "green haired tortoises" are occasionally kept by the gardeners and sometimes they have a good sale.

"Mino-game" are popular among Japanese people and the animals may probably have a fairly wide distribution in the country, but any scientific investigation has hardly been executed by phycologists of Japan. Once, Dr. H. NAKANO (1919) gave a brief account on the green algae growing on the shells of pond tortoises, but he did not perform any actual study. And later in 1920, Dr. K. YENDO gave a brief description of *Chaetomorpha Chelonum* COLLINS var. *japonica* YENDO from Prov. Iyo. This variety belongs probably to *Basycladia crassa*. According to Mr. S. KITAJIMA, the late K. MINAKATA noticed the occurrence of the filamentous green alga on the pond tortoises bred at his garden, but he was too prudent to publish any report.

Several workers of Europe and America recorded the algae growing on the shells of living turtles. COLLINS (1909) described for the first time on an alga collected from the carapace of a snapping turtle and he referred it to the *Chaetomorpha*. But HOFFMANN and TILDEN collected an alga from the shells of living snapping turtle, *Chelydra serpentina*, in Minnesota, and after careful examination they noticed some fundamental characteristics separating it from *Chaetomorpha*. The species of *Chaetomorpha* possess unbranched erect filaments, while the alga under consideration has a heterotrichous habit, i.e. the little branched erect filaments arising from creeping threads. Thus they established a new genus *Basycladia*, giving descriptions of the two species, *B. crassa* and *B. chelonum*. COLLINS' *Chaetomorpha chelonum* was identified as *B. chelonum*.

Later in 1935, C. C. WANG furnished an information on the occurrence of *Basycladia crassa* and *Cladophora glomerata* (L.) KÜTZ. var. *nana* WANG in China. According to this report, the former species has a wide distribution, but the latter has been found to be rare. In addition to these filamentous green algae, a

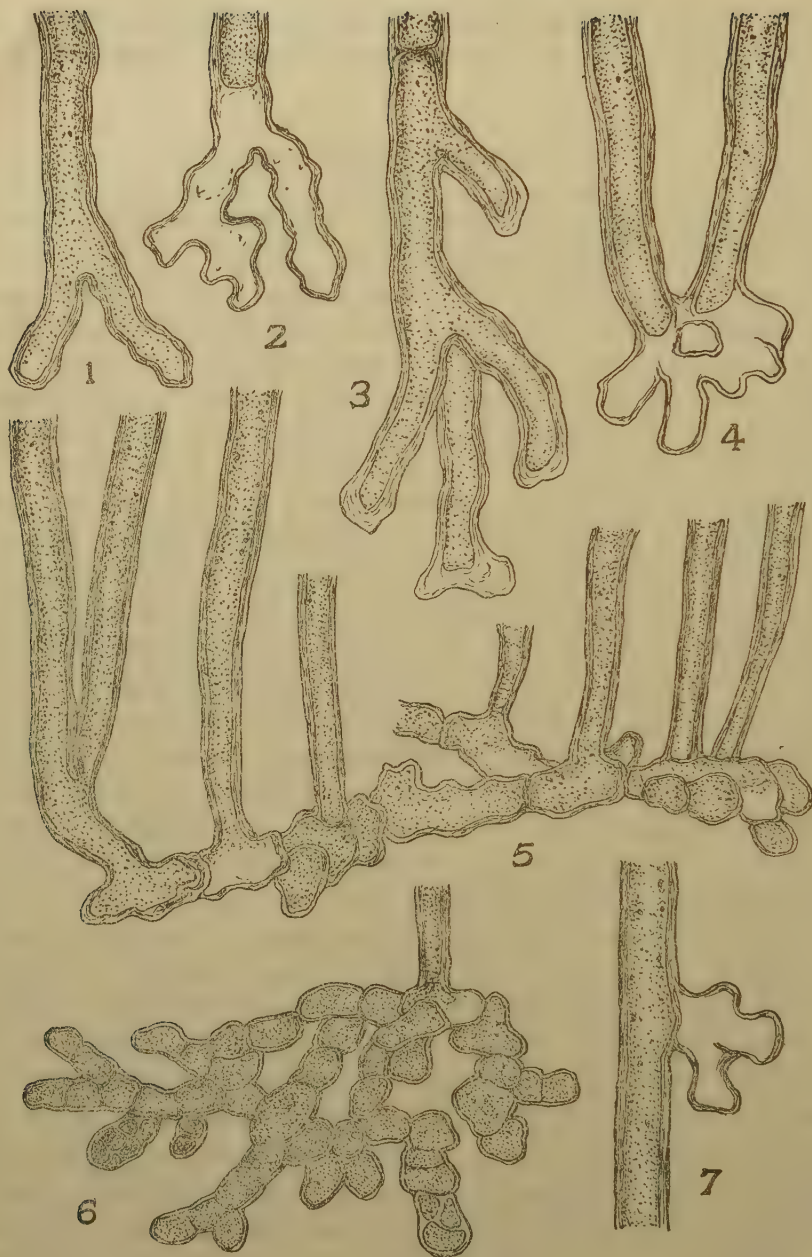
prostrate form on the carapace has been known. It is *Ulvella involvens* (SAVI) SCHMIDLE, a species of *Chaetophoraceae*, recorded from European and American fresh-water turtles.

Observations

The present alga was collected from the shells of the pond tortoises, *Clemmys japonica*. The animal is known as "Ishi-game" in Japan, and in its younger age it is often called "Zeni-game." The present tortoises are about 10 cm in length. The green filaments are forming tufts and densely covering the dorsal surface of the animals. The alga has been identified as *Basycladia crassa* HOFFMANN & TILDEN. It generally agrees with the original description and that of WANG. Although some differences may be found in detailed structures, they may be attributed to the different conditions of life.

The alga has an interesting habitat, that is the host animals enjoy an amphibious life and the alga together is under allied conditions. This alga is occasionally exposed to the atmospheric air according to the behaviour of the animals. The exposure may be short or long in time, but is never periodical as is in the case of marine algae of tidal zone. It is an encouraging problem to make clear up how the alga can stand the indefinite dryness. The alga does not excrete gelatinous material on its surface and cannot be protected from desiccation by means of gelatinous sheaths like some subaerial algae. The thick stratified membranes, however, probably serve as some protection. It is interesting characteristics that most species of *Cladophoraceae* have cells thick-walled but without gelatinous sheaths, and inhabit in waters well aerated.

The fact that a number of epizoic algae can afford to grow on definite hosts is commonly known. Now for the substratum of *Basycladia*, it has been known to be strictly limited to the shells of living tortoises. According to C. C. WANG, she failed to find the same species of *Basycladia* on any other animal or on some other materials from places where the tortoises lived. As for the special selection of substratum in the species of *Basycladia*, the writer has devoted attention and found in the present investigation an occasional exception to the generally accepted assertion. The present alga grows densely covering almost all the dorsal surface of the animal, and, what is more, it thrives also on the part of basin-wall to a considerable extent. The present tortoises with their algal community have been brought from the garden of the late K. MINAKATA and have been kept in a porcelain basin filled with clear water drawn from a well. The algal tufts on the basin-wall may have their origin in the algal growth on the tortoises. Some detached filaments may have attached to grow on the wall, but perhaps the anchoring of liberated



Figs. 1-7. 1-4, irregularly lobed outgrowths of the attaching basal cells; 5, prostrate filaments from which arising several basal cells of the upright filaments, the left one showing the characteristic basal branching; 6, basal creeping filaments, composed of short cells; 7, a part of one cell in the median portion of the upright filament with a lobed rhizoid-like outgrowth. All $\times 500$.

swarmers is more probable origin of this special occurrence. After careful examination, the algae attached to these different substrata, the shells and the basin-wall, have been proved to be the same plant. The density of algal growth on the part of the tortoises has been more vigorous than on the part of the basin-wall, but the highest elongation of individual filaments has been attained in the latter. *Basicladia crassa* is permanently attached to the shells of living tortoises or occasionally as in this case grows on some other substrata, usually forming dense tufts. It is bright or dark green in colour, somewhat rigid in feeling. According to Mr. S. KITAJIMA, the upright filaments attain to the flourishing condition in cold season, becoming short in warm and hot seasons. The growth relation, however, is probably otherwise in wild state.

As mentioned above, *Basicladia* is heterotrichous, composed of creeping filaments and upright filaments arising from them. Attachment is effected by rhizoidal outgrowths of the basal cells or by a number of creeping irregularly septate filaments, branched or unbranched (Figs. 1-6, 9, 10). They are often intricately together to form a dense continuous expansion on the shells, and are often coralloid in appearance. The rhizoidal outgrowths of the basal cells are usually irregularly branched, rarely unbranched; colourless or often with chloroplast extended from the basal cells. The rhizoidal outgrowths are occasionally found in the cells of upright filaments (Fig. 7). The cells of creeping filaments are irregular in shape and in size, and may be empty or filled with protoplasts. Some of them may divide into a number of short cells, which contain chloroplast and filled with protoplasm (Fig. 8). These cells may probably be a kind of storage-cells, and may have abilities of propagation and perennation hereafter. The function of these cells has not yet been confirmed in this study, but at least the presence of this sort of cells is the first record for *Basicladia*.

The upright erect filaments are straight, cylindrical. The regular but little branching at the basal cells was found by HOFFMANN and TILDEN, and upon this basis they separated *Basicladia* from *Chactomorpha* (Fig. 5). Lateral branching are occasional, mostly arising from the cells of lower portions of erect filaments and rarely in the upper (Figs. 8, 9, 14). The upright filaments are not or usually more or less constricted at the cross walls, especially in the upper portion. They are somewhat tapering or becoming rather broad toward the apex.

The cells are usually cylindrical, but often varying in shape as well as in size according to the position in the filaments or to the degree of maturity. In younger stage, cells generally cylindrical in shape, and have almost the same size throughout the whole length of the filaments.



Figs. 8-14. 8, a part of a filament with a short lateral branch; 9, lower portion of a single filament with creeping branched filaments; 10, characteristically elongate basal cell with its outgrowth; 11, the median portion of the same filament, showing cylindrical cells; 12, the apical portion of the same showing somewhat short and broad cells; 13, the apical portion of a filament, showing several subglobose cells and assumed zoosporangia; 14, a part of a filament with a lateral branch. All $\times 500$.

In mature filaments, cells of the lower portions are also cylindrical, but those of the upper portions are often short and broad, barrel shaped to sub-globose, frequently arranged in a moniliform series. Basal cells are elongate, often very long; apical cells are short or long, cylindrical or ellipsoidal to ovoid, with rounded or somewhat pointed apex.

The cell membranes are thick and stratified distinctly. In younger plants they are, of course, somewhat thin and slightly stratified, but in older they become thick and about 3 to 6 stratifications are visible under microscope. The surface of membrane is rather smooth in younger state, but somewhat roughened at maturity, especially in the lower portions of upright filaments.

The fructiferous cells, presumably zoosporangia, are usually formed in the upper portions of the filaments, single or in series. They are cylindrical to almost globular (Fig. 13). In regard to the characters of the living zoospores, the writer cannot say any particular. But they must be liberated through an aperture near the middle of lateral wall of the sporangia. Several empty sporangia are occasionally observed in the material.

Various measurements of the present alga are as follows: The whole length of the upright filaments 2-5 cm.; basal cells $32-120\mu$ in diameter, $415-3175\mu$ in length, up to 30 or more diameters long; following cells $37-125\mu \times 140-450\mu$, 2-8 diameters long; apical cells $30-95\mu \times 60-275\mu$, 1.5-3 diameters long; sporangia $63-127\mu \times 70-215\mu$, 1-1.5 diameters long; cells in younger filaments $20-25\mu$ in diameter, $110-186\mu$ in length, up to 8 diameters long.

As for the position of the alga in classification system, it has generally been thought to be a genus belonging to the family *Cladophoraceae*. But the heterotrichous habit of *Basicladia* has not been observed in other genera of the family, and thereupon its inclusion among the same family is a question to be solved. Considering from the cell structure, some affinity with *Cladophora* and *Chaetomorpha* is undoubtful. FRITSCH, F. E. (1935) treated in his excellent volume the genus *Basicladia* briefly at the end of the chapter of *Cladophorales*.

Now some mention must be made of a number of fresh-water algae epiphytic on or accompanied with *Basicladia crassa*. The absence of gelatinous sheaths in *Basicladia* makes the outer surface of the filaments a favourable substratum for the growth of epiphytes. The epiphytic members are mostly filamentous green algae such as *Ulothrix tenerrima* Kürz., *U. aequalis* Kürz., *Stigeoclonium tenue* (Ag.) Kürz. and *Oedogonium* sp. One species of *Xenococcus* (*Cyanophyceae*) is also found. These epiphytes often densely cloth the old filaments of *Basicladia crassa*. A certain species of minute dimensions belonging to several groups of algae are found growing on or intermingled

with the *Basicladia* and these epiphytes. Some of them are as follows: *Chroococcus minor* (Kütz.) NÄGELI, *Oscillatoria brevis* Kütz., *Navicula cincta* (EHRB.) Kütz., *Gomphonema parvulum* (Kütz.) GRUN., *Scenedesmus obliquus* (TURP.) Kütz., *S. quadricauda* (TURP.) BRÉB. f. *typicus* CHODAT, *Cosmarium angulosum* BRÉB.

Summary

An alga growing on the shells of the pond tortoises, *Clemmys japonica*, is for the first time recorded in Japan. The host animals have been bred in a porcelain basin at a quadrangle in Tanabe City, Wakayama Pref. After examination, the alga has been determined as *Basicladia crassa* HOFFMANN & TILDEN. Morphological observations on the alga are described in detail.

The alga has hitherto been known to grow only on the pond tortoises, but the present investigation has shown the possibility of its occurrence on other substratum. As for the prostrate filaments, the writer found a kind of storage-cells, filled with chloroplast and other materials.

Although the alga has cells quite resembling those of *Chaelomorpha* and *Cladophora*, its inclusion among the family *Cladophoraceae* is a problem to be solved, considering the heterotrichous habit. It must be also an interesting subject to give a full account of the peculiar amphibious habitat and to follow up its life-cycle.

Several species of the algae growing on or accompanied with *Basicladia crassa* are briefly mentioned.

LITERATURE REFERRED TO

- COLLINS, F. S. 1909. The Green Algae of North America. Tufts Coll. Stud. 2, p. 326.
 FRITSCH, F. E. 1935. The Structure and Reproduction of the Algae. Vol. I, p. 246.
 HOFFMANN, W. E. & TILDEN, J. E. 1930. *Basicladia*, a new genus of *Cladophoraceae*. Bot. Gaz. 89, pp. 374-384, figs. 1-22.
 SMITH, G. M. 1933. The Fresh-water Algae of the United States. p. 432.
 TILDEN, J. E. 1935. The Algae and their Life Relations. p. 408, fig. 214.
 WANG, C. C. 1935. Algae growing on the Pond Tortoise. Contrib. Biol. Lab. Sci. Soc. China. 10, pp. 4-12, figs. 2-4.
 YENDO, K. 1920. Novae Algae Japoniae. Bot. Mag. Tokyo 34, p. 1.

SOME MARINE CYANOPHYCEAE FROM THE SHIRAHAMA COAST OF WAKAYAMA PREFECTURE*

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With 3 Text-figures

Shirahama of Wakayama Prefecture is located on the southwest coast of the Kii Peninsula, and is well known as hot-spring town from old times. The Marine Biological Laboratory, Faculty of Science, Kyoto University is situated in the town, and many zoologists and algologists visit it for collecting materials or for other biological studies.

The late Dr. K. OKAMURA (1932) reported on the algal flora of this coast, but he did not touch upon the marine Cyanophyceae. So far as the writer is aware no one has previously made a collection concerning the marine Cyanophyceae of this region. Therefore the study of the flora of marine Cyanophyceae of this coast seems to the writer both interesting and important. The writer made three journeys in May, August and November, 1951, to Shirahama for this purpose.

The species identified amount to 39 in all, of which 3 belong to the Chroococcaceae, 6 to the Pleurocapsaceae, 1 to the Dermocarpaceae, 2 to the Mastigocladaceae, 5 to the Rivulariaceae and 21 to the Oscillatoriaceae. *Microcoleus tenerrimus* GOM. var. *longus* is described as new variety. *Aphanocapsa littoralis* HANSG. var. *macrococca* HANSG., *Pleurocapsa minuta* GEITL., *Pl. fuliginosa* HAUCK, *Xenococcus Gilkeyae* SETCH. et GARDN., *Hyella Balani* LEHM., *Myxohyella socialis* (SETCH. et GARDN.) GEITL., *Kyrtulthrix dalmatica* ERCEG., *Calothrix pilosa* HARV., *C. codicola* SETCH. et GARDN., *Phormidium epiphyticum* GARDN., *Ph. constrictum* KLASS, *Lyngbya gracilis* RAB., *Microcoleus Boergesenii* (GARDN.) FRÉMY, *M. chthonoplastes* THUR., *M. tenerrimus* GOM., *Hydrocoleum cantharidosmum* (MONT.) GOM. and *Shizothrix lacustris* A. BRAUN are new to Japan.

The writer wishes to express his sincere thanks to Dr. Y. YONEDA, under whose direction this work has been carried on, and to Dr. Y. YAMADA of

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Hokkaido University, for kind advices during the course of the present study. Thanks are also due to Dr. H. UTINOMI who helped him with much kindness during his stay at the Marine Biological Laboratory.

Enumeration of species

CYANOPHYCEAE

Chroococcaceae

1. *Chroococcus turgidus* (KUETZING) NAEGELI, Gatt. einzell. Alg. 46 (1849); GEITL., Cyan. in RABENH., Kryptogamenfl. 14: 228, figs. 109 b, 110 (1930).

Hab.: Seto (May 22; November 1). On rocks or among other Cyanophycean algae in the high tide level.

Bansho-ura (November 1). With other Cyanophyceae in the littoral belt.

Hatake-jima (August 2). Associated with *Calothrix pilosa* HARV. on rocks in the high tide level.

This species is fairly common in the Shirahama coast, and it was found on the every opportunity of collections in May, in August and November. The plants are mostly one, two and four-celled, but the eight-celled individuals are hardly observed. The cell membranes are hyaline, lamellated and up to 3μ in thickness. The cell contents are yellowish green, grass green or lavender blue and with often large dense granules.

2. *Aphanocapsa littoralis* HANSGIRG var. *macrococca* HANSGIRG, Beitr. Kenntn. Meeresalg. u. Bact. Fl. 229 (1892); GEITL., Cyan. in RABENH., Kryptogamenfl. 14: 153 (1930); UMEZAKI, Journ. Jap. Bot. 27(7): 219 (1952.)

Hab.: Seto (May 22). Growing on rocks in the littoral belt.

The mass of the colonies is irregularly and widely expanded on rocks, gelatinous and dark green in colour. The cells are densely scattered in the hyaline and gelatinous stratum, spherical or lengthwise longer, and $6-10\mu$ in diameter. The cell membranes are hyaline and thin.

3. *Microcystis Reinboldii* (RICHT.) FORTI in DE TONI, Syll. Algar. 5:91 (1907); GEITL., Cyan. in RABENH., Kryptogamenfl. 14:134 (1930); FRÉMY, Cyan. Côtes d'Eur. 10, pl. 1, fig. 7 (1934).

Hab.: Hatake-jima (August 2). Growing on sands in the littoral belt in company with other Cyanophyceae.

This specimen forms a large, soft and membranous mass which aggregated into many small colonies among the filaments of other Cyanophyceae.

Pleurocapsaceae

4. *Pleurocapsa minuta* GEITLER, Cyan. in RABENH., Kryptogamenfl. 14: 355, fig. 18 c-f (1931).

Hab.: Yuzaki (October 31). Growing on the fronds of *Kyrtuthrix dalmatica* ERCEG.

This plant was abundantly found among the upper portions of the fronds of *Kyrtuthrix dalmatica* ERCEG. The cells are 2.5-7.5 μ in diameter, and mouse colour or greyish green in colour. Almost the characteristics of this material are the very same as the diagnosis and figures given by GEITLER, though it is different from *Dalmatia* specimen in habit.

5. *Pleurocapsa fuliginosa* HAUCK, Meeresalg. in RABENH., Kryptogamenfl. 2: 515, fig. 231 (1885).

Hab.: Seto (May 22). Growing on rocks in the littoral belt.

This specimen is scarcely found, but it agrees with the description and figure given by HAUCK in many characteristics.

6. *Xenococcus Gilkeyae* SETCHELL et GARDNER, in GARDNER, Univ. Calif. Publ. Bot. 6: 462, pl. 39, fig. 11 (1918); UMEZAKI, Journ. Jap. Bot. 27(7): 220, fig. 20 (1952).

Hab.: Seto (August 3). On the filaments of *Lyngbya semiplena* J. AG., which grow on rocks in the littoral belt.

Yuzaki (October 31). On the filaments of *Lyngbya semiplena* J. AG., *L. confervoides* C. AG. and *L. lutea* (AG.) GOM.

These specimens are typical in all characteristics, and the plants are fairly commonly found on the filaments of the genus *Lyngbya* in this region.

7. *Oncobyrsa adriatica* HAUCK, Meeresalg. in RABENH., Kryptogamenfl. 2: 515, fig. 230 (1886); INAGAKI, 14th general Meet. of Bot. Soc. Jap. (Lecture, April 1950).

Japanese name: Iwahige-no-kobu (K. INAGAKI).

Hab.: Seto (November 2). On a shell in the littoral belt.

In the material, the fronds were found on a shell, and up to 3 mm in diameter. Though they differ from the reports of other collectors till now in habit, the other characteristics are the very same as those of the specimens which were sent to the writer from Mr. K. INAGAKI, who collected at Cape Mikawa-irako, Aichi Prefecture in 1950, growing epiphytically on *Myelophycus caespitosus* (HARV.) KJELLM.

8. *Hyella Balani* LEHMANN, Ueber *Hyella Balani* in Nyt. Mag. Naturvid. 41: 85, pl. 2, figs. 1-2 (1902); GEITL., Cyan. in RABENH., Kryptogamenfl. 14: 370, fig. 199 (1931).

Hab.: Seto (May 22). Growing on an Oyster living in the high tide level. A part of the filaments penetrates into the shell of an Oyster, and the

filaments are irregularly or dichotomously branched, blue green in colour. The membranes are thick, hyaline and not lamellated. The cells are $4-8\mu$ in diameter, and short, spherical or rectangular, varying in shape. The end cells of the penetrating filaments are long, often up to 20μ in length. The sporangium is not observed in the materials at hand.

9. *Myxohyella socialis* (SETCHELL et GARDNER) GEITLER, Beih. Bot. Centralbl. 2 (41) : 247 (1927) ; UMEZAKI, Journ. Jap. Bot. 27 (7) : 220, fig. 21 (1952).

Hyella socialis SETCH. et GARDN. in GARDNER, Univ. Calif. Publ. Bot. 6 : 443, pl. 36, fig. 5 (1918).

Hab.: Seto (May 22). Endophytic in a red alga, *Polysiphonia* sp.

This plant is an endophytic species growing under the epidermis of *Polysiphonia*, irregularly branching in the host, and reaching $100-200\mu$ in length. The cells are rectangular or mostly depressed in shape and $3.5-6\mu$ in diameter. The terminal cells of this plant are often ellipsoidal or somewhat longer than those of the descriptions and figures given by GARDNER, and sometimes measuring 20μ in length. The sporangium is unknown. Other characteristics of this material, however, agree very well with GARDNER's descriptions.

Dermocarpaceae

10. *Democarpa Leibleiniae* (REINSCH) BORNET et THURET, Notes algol. 2 : 73, pl. 25, figs. 3-5 (1880) ; GEITL., Cyan. in RABENH., Kryptogamenfl. 14 : 399, fig. 224 (1931) ; UMEZAKI, Journ. Jap. Bot. 25 (9-12) : 225, fig. 3 (1950).

Hab.: Seto (August 3). Epiphytic on *Sphacelaria* sp. and *Cladophora* sp. in the littoral zone.

In Japan, this species was for the first time discovered by the writer from Wakasa-takahama, Wakasa Bay, Fukui Prefecture, in 1950, and it was abundantly found growing on the plants of *Sphacelaria* and *Cladophora* by the present collection from Seto. The cells are from ovoid to long pear-shape, $9-16\mu$ in diameter at the apex and $15.5-21\mu$ in length. The membranes are $1.5-3.5\mu$ in thickness, hyaline and conspicuously lamellated. Their mature sporangia are $11-18\mu$ in diameter at the apex, $20-30\mu$ in length and contain 5-18 endospores with a diameter from 2.5μ to 5.5μ .

Mastigocladaceae

11. *Brachytrichia Quoyi* (AGARDH) BORNET et FLAHAULT, Rév. Nost. het. 2 : 373 (1886) ; GEITL., Cyan. in RABENH., Kryptogamenfl. 14 : 554, figs. 347, 348 (1931).

Japanese name: Aimidori (K. OKAMURA).

Hab.: Seto (May 22). On rocks in the lower to upper littoral belt.

This species are, according to Dr. H. UENOMI, abundantly found during the spring season, from March to June. The fronds are less than 2 cm. in diameter. The writer observed in the fronds of *Nemalion multifidum* (W. et M.) J. AG. the very same plants as those which were figured and described as young plant of *Hormactis Balani* by BARNET and THURET (Notes algol. pl. 44, figs. 1-2, 1878). But, such a plant could not be found on rocks. It is doubtful whether the plants which were found in *Nemalion multifidum* are young plants of *Brachytrichia Quoyi* or other Cyanophycean species. For the determination, it certainly seems necessary to perform a developmental experiment in culture of this species.

In 1932, N. GARDNER gave a detailed note on the genus *Brachytrichia*. As he pointed out in his report, the writer also can not agree with such a treatment made by L. GEITLER (in RABENHORST, Kryptogamenfl. 14: 554) who combined all the species into one. Moreover, the appropriate name in the combination seems to be *B. Quoyi* based upon *Nostoc Quoyi* of C. AGARDH.

12. *Kyrtuthrix dalmatica* ERCEGOVIĆ, Arch. f. Protok. 66 (1): 170, fig. 3 (1929); GEITL., Cyan. in RABENH., Kryptogamenfl. 14: 557, fig. 349 (1931).

Brachytrichia dalmatica (ERCEG.) FRÉMY, Cyan. Côtes d'Eur. 162, pl. 51, fig. 2 (1934).

Hab.: Throughout the coast of Shirahama (from March to December). On rocks in the high tide level or more upper.

The fronds are flatly and widely expanded on rocks, somewhat endolithic, blackish green in a fresh state, but black on drying and very hard. The filaments are up to $255\ \mu$ in height, $10\text{--}15.5\ \mu$ in diameter, mostly parallel and not readily separable by pressure. The sheaths are hyaline at the base of the filaments and light brown at the upper portion. The trichomes are single within a sheath, mostly parallelly or irregularly bending, and attenuating into a short and delicate hair above. The cells are $2.5\text{--}9.5\ \mu$ in diameter, $2.8\text{--}10.5\ \mu$ in length, and their shape are short, spherical, barrel-shaped or ellipsoidal. The heterocysts are intercalary, several in a trichome, and their shape are short, spherical or long ellipsoidal, $6\text{--}10.5\ \mu$ in diameter and $4.5\text{--}15.5\ \mu$ in length. The hormogonia are unknown.

This species is very commonly and abundantly found in the Shirahama coast, throughout the year. By reason of that young plant of *Hormactis Balani* THUR. has just the same morphological characters as those of adult plant of *Kyrtuthrix dalmatica* ERCEG. which was established by M. ERCEGOVIĆ in 1929 and also the latter alga quite resembles *Brachytrichia maculans* GOM., P. FRÉMY (1934) combined *Kyrtuthrix* with *Brachytrichia* and gave the name *B. dalmatica*

(ERCEG.) FRÉMY. At present, remaining *Brachytrichia* and *Kyrtuthrix* as separate genus, both the genera seem to be valid from their ecological, morphological and developmental points.

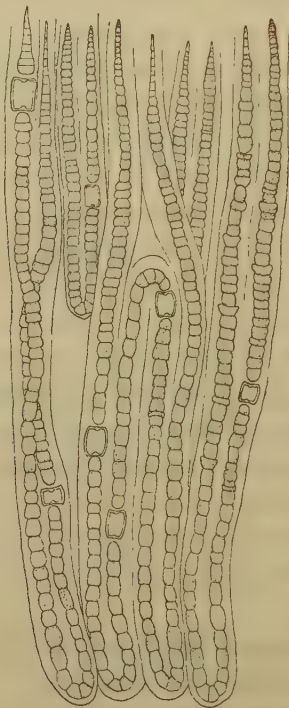


Fig. 1. *Kyrtuthrix dalmatica* ERCEGOV.Ć.
Part of the vertical section of a thallus ($\times 750$).

Rivulariaceae

13. *Calothrix parasitica* (CHAUV.) THURET, Ess. Class. Nost. 381 (1875); BORN. et THUR., Notes algol. 2: 157, pl. 37, figs. 7-10 (1880).

Hab.: Seto (May 22). Growing in the fronds of *Nemalion multifidum* (W. et M.) J. AG., *N. pulvinatum* GRUN. and *Helminthocladia australis* HARV.

The morphological characteristics in each host of this species are typical. In the United States and Europe, this species is discovered in the fronds of various Rhodophyceae and Phaeophyceae, especially commonly in the fronds of *Nemalion multifidum* and *N. lubricum*. From this region, the writer found it in the fronds of *Nemalion multifidum*, *N. pulvinatum* and *Helminthocladia australis*. *Helminthocladia*, especially *Nemalion*, with the soft gelatinous fronds

seem to be favorable hosts for *C. parasitica*, probably due to some ecological relations between both the plants. As the result of parasitism of *C. parasitica*, the fronds of *Nemalion multifidum* show often blue green colour, as if it were a different alga.

14. *Calothrix pilosa* HARVEY, Ner. Bor. Amer. 3: 106, pl. 48 c (1858); FRÉMY, Dansk. Bot. Ark. 9 (7): 36, fig. 4 (1939).

Hab.: Seto, Hatake-jima, Ka-shima and Yuzaki (May 22; August 2; October 31). On rocks in the high tide level or a little above.

This species and *Kyrtuthrix dalmatica* ERCEG. are very common algae found on rocks of the uppermost tide belt in the Shirahama coast.

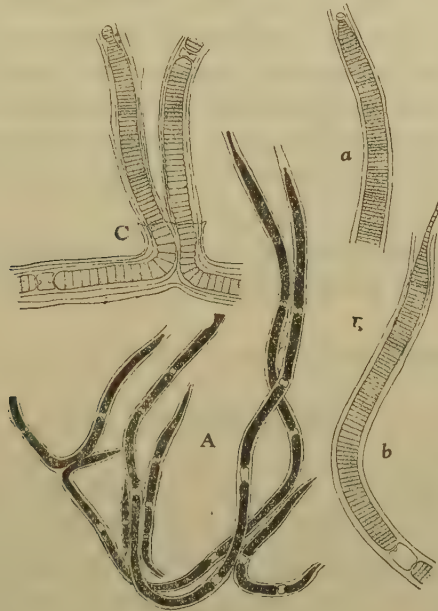


Fig. 2. *Calothrix pilosa* HARVEY. A, habit ($\times 10$); B, upper portions of two filaments ($\times 25$), a, ending to a button-like apex, b, ending to a hair at the end of trichome; C, part of a filament showing a scytonemous pseudobranching ($\times 25$).

The filaments form a widely and densely expanded, intricate, dark green stratum on rocks, black on drying, decumbent at the middle, both ends erect upwards, up to 5 mm in height, $30-43\ \mu$ in diameter, often attaching one another with their sides, and sometimes scytonemously pseudo-branched. The sheaths are yellow to light brown at the decumbent portions of the filaments, mostly hyaline at the erect portions, lamellated, and up to $11\ \mu$ in thickness.

The trichomes are $18-27.5\mu$ in diameter, blue-green to deep blue green, above briefly attenuated, and the end of the hair often button-like. The cross walls are usually constricted or often not. The dissepiments are not granulated. The cells are $2.1-9.2\mu$ in length, and about $\frac{1}{2}-\frac{1}{9}$ ($-\frac{1}{12}$) time as long as the diameter. The cell contents often with large, dense granules. The heterocysts are intercalary, numerous, $9-47\mu$ in length, and short, quadrate or cylindrical in shape.—Fig. 2.

15. *Calothrix codicola* SETCHELL et GARDNER, Proc. Calif. Acad. Sci. IV, 19 (11): 124, pl. 4, fig. 4 (1930).

Hab.: Senjyo-jiki (October 31). Among other Cyanophycean algae growing on rocks of a small tide pool, in the high tide level.

The materials at hand were found growing among the fronds of *Hydrocoleum* and other Cyanophycean algae. The filaments are $300-440\mu$ in length, $12-18\mu$ in diameter at the slightly thickened base, and $9-12\mu$ in diameter at the middle. The sheaths are hyaline, thin or often thick, and up to 3μ in thickness. The trichomes are $9-12\mu$ in diameter at the base, $4.5-6.5\mu$ in diameter at the middle, and their ends are tapering into a short or often long delicate hair.

This material differs from the original diagnosis in habit, but in other characteristics, it rather seems to belong to *Calothrix codicola* than the other species of *Calothrix*.

16. *Isactis plana* (HARVEY) THURET in BORN. et THUR., Notes algol. 2: 163, pl. 40 (1880).

From the Shirahama coast, the following two varieties were collected.

a). var. *fissurata* BORN. et FLAH., Rév. 2: 344 (1886).

Hab.: Yuzaki (May 22). Growing on *Helminthocladia australis* HARV.

Seto (May 22). Growing on rocks in the littoral belt.

Specimens on *Helminthocladia australis*: The filaments are $270-330\mu$ in height and blue-green in colour. The sheaths are hyaline. The trichomes are $6-9\mu$ in diameter at the base, and $3.5-8.5\mu$ in diameter at the middle.

Specimens on rocks: The filaments are about 400μ in height. The sheaths are light brown at the upper portion, and hyaline at the base. The trichomes are $4.5-11\mu$ in diameter at the base, and $4-6\mu$ in diameter at the middle.

b). var. *plana* BORN. et FLAH., Rév. 2: 344 (1886).

Hab.: Yuzaki (May 22). Growing on pebbles in the littoral belt.

The height of the filaments are from 200μ to 220μ . The trichomes are $6-10.5\mu$ in diameter at the base, and $5-8\mu$ in diameter at the middle. The cross walls are conspicuously constricted. The sheaths are yellowish brown in colour, and thick. The cells are $\frac{1}{3}-1$ time as long as the diameter.

17. *Rivularia atra* ROTH in GEITLER, Cyan. in RABENH., Kryptogamenfl. 14: 645, fig. 410 b, c (1931).

Hab.: Seto (November 2). On rocks in the lower littoral belt.

The fronds are blackish green, hemispherical in shape, very hard, individual plants up to 0.5 cm. in diameter, and masses formed by mutual union up to 1 cm in diameter. The sheaths are hyaline, thick, up to 4.5μ in thickness, and opening instead of vanishing at the apex. The trichomes are crowded, not separable by pressure, $2-5.5\mu$ in diameter at the inner part of the frond, $4.5-6\mu$ in diameter at the outer part of the frond, and tapering into a long hyaline delicate hair above. The cells are $2-3\mu$ in length at the apex of the trichome in the outer part of the frond, $1-\frac{1}{3}$ time as long as the diameter, mostly $7.5-18\mu$, but sometimes up to 33μ in length at the inner part of the frond, mostly 2.5-6 times, but sometimes 6-11 times as long as the diameter. The heterocysts are basal. The basal heterocysts are usually single, sometimes up to three in series, spherical or hemispherical, and $5-11\mu$ in diameter. The arrangement of the basal heterocysts shows usually concentric zonations in vertical section of the frond.

Rivularia atra ROTH is common in the Shirahama coast, and it is very common in the Japanese coast as described in "Synoptic List of Japanese Algae" by the late Dr. K. OKAMURA (1916).

Oscillatoriaceae

18. *Spirulina socialis* GARDNER, Sci. Surv. Porto Rico & Virgin Isl. 8 (2): 272, pl. 1, fig. 1 (1932); UMEZAKI, Journ. Jap. Bot. 27 (7): 221, fig. 22 (1952).

Hab.: Seto (August 3). Epiphytic on *Hydrocoleum lyngbyaceum* which grows on rocks in the littoral belt.

The characteristics of this material are typical, and agree well with the descriptions given by GARDNER. The plants form solitary or mostly gregarious colonies on the sheath of *Hydrocoleum lyngbyaceum*, and their trichomes are lengthwise parallelly epiphytic on host sheath.

19. *Oscillatoria chalybea* MERTENS var. *anguina* GOMONT, Monogr. des Oscill. 233 (1892); UMEZAKI, Journ. Jap. Bot. 27 (4): 117, fig. 17 C (1952).

Hab.: Ka-shima (August 2). Among the filaments of *Hydrocoleum lyngbyaceum* on rocks in the littoral belt.

The trichomes are yellowish green, loosely and irregularly spiral or sometimes twisted, and $9-12\mu$ in breadth. The cells are $3-6.4\mu$ in length, and $\frac{1}{2}-\frac{1}{3}$ time as long as the diameter.

20. *Oscillatoria laetevirens* (CROUAN) GOMONT, Monogr. des Oscill. 226, pl. 7, fig. 11 (1892); UMEZAKI, Journ. Jap. Bot. 26 (9): 267, fig. 13 B (1951).

Hab.: Seto (May 22). Among other Cyanophyceae growing on oyster shells in the littoral belt.

A few materials were found among the fronds of *Calothrix* or other Cyanophycean algae. The trichomes are $2.6-4\mu$ in diameter, and $2.5-4.5\mu$ in length, and their apical cells are long, and $2.5-6.6\mu$ in length.

21. *Oscillatoria nigro-viridis* THWAITES in GOMONT, Monogr. des Oscill. 217, pl. 6, fig. 20 (1892); UMEZAKI, Journ. Jap. Bot. 26 (9): 267, fig. 13 A (1951).

Japanese name: Kuro-yuremo (I. UMEZAKI).

Hab.: Bansho-zaki (November 2). With other Cyanophyceae on rocks in the littoral belt.

The plants were rarely observed among other Cyanophyceae. The trichomes are $7-9\mu$ in diameter. The cells are $2.5-4.5\mu$ in length. Other characteristics are typical.

22. *Oscillatoria Corallinae* (KUETZING) GOMONT, Monogr. des Oscill. 218, pl. 6, fig. 21 (1892); UMEZAKI, Journ. Jap. Bot. 26 (9): 268, fig. 13 C (1951).

Hab.: Seto (May 22; November 2). On *Corallina* sp. in the littoral belt.

Yuzaki (October 31). Among the mass of *Calothrix pilosa* HARV.

The materials were rarely found.

23. *Phormidium epiphyticum* GARDNER, Sci. Surv. Porto Rico & Virgin Isl. 8 (2): 281, pl. 1, fig. 1 (1932).

Hab.: Senjyo-jiki (October 31). On the sheaths of *Hydrocoleum lyngbyaceum* KUETZ. which grows on rocks of a small tide pool, in the high tide belt.

The filaments of this species are very densely and parallelly encircling the sheaths of *Hydrocoleum lyngbyaceum* Kuetz. The characteristics are typical.

24. *Phormidium constrictum* KLAS, Acta Adriat. 2 (2): 77, fig. 2 (1938).

Phormidium nosiochoides JAO, Bot. Bull. Acad. Sinica 2: 169, fig. 1 g (1948).

Hab.: Hatake-jima (August 2). On rocks in the littoral belt.

The plants form an irregularly expanded, olive-green and somewhat membranous stratum on rocks. The filaments are irregularly intricated. The sheaths are hyaline, thin when young, later thick, not lamellated, and not diffuent. The trichomes are $1-1.7\mu$ in diameter, and not attenuating at the terminals. The cross walls are conspicuously constricted. The dissepiments are not granulated. The protoplasm is light blue-green. The end cells of the trichomes are neither capitated nor calyptrated.

Phormidium constrictum was described as new by Z. KLAS from the Adriatic Sea, Europe in 1938. C. JAO, in 1948, reported *Phormidium nostochoides* as new based on the materials collected from San Juan Island, Washington, U.S.A. in

1935. The writer collected an alga from the Shirahama coast having exactly the same features as the descriptions and figures given by them. From the observations of this material and comparative studies between both the specific diagnoses described by them, these two species seem most probably to be identified as one. So, according to the principle of the priority of publication, the specific name *Phormidium constrictum* given by Z. KLAS should be used.

25. *Lyngbya Kuetzingii* SCHMIDLE. Allg. Bot. Zeitschr. 58 (1879); UMEZAKI, Journ. Jap. Bot. 26 (7) : 203, fig. 7 (1951).

Japanese name: Tachi-ringubia (I. UMEZAKI).

Hab.: Seto (May 22; November 2). Growing on *Cladophora* sp. in the littoral belt.

The characteristics in this material are typical. In Japan, this species was first found growing epiphytically on *Pithophora* sp. by Dr. Y. YONEDA from Takemoto Spring in 1938, and the writer rediscovered it growing on *Gelidium* sp. from Maizuru Bay in the Japan Sea coast in July 1951, and by the present collection he has found it again from marine as mentioned above.

26. *Lyngbya Nordgardhii* WILLE. Nyt. Mag. Naturv. 55: 32 (1917); UMEZAKI, Journ. Jap. Bot. 26 (7) : 203, fig. 8 (1951).

Hab.: Seto (May 22). Growing on *Cladophora* sp. and young plants of *Enteromorpha* sp. near the high tide level.

This species was published by the writer from Kunda Bay, Kyoto Prefecture as new record for Japan, July 1951. The characteristics are entirely similar to the typical form.

27. *Lyngbya epiphytica* HIERONYM. in ENGLER-Plantl, Nat. Pflanzenf. 1 (1 a) : 67 (1898); UMEZAKI, Journ. Jap. Bot. 25 (9-12) : 226, fig. 5 (1950).

Japanese name: Itomakimo (I. UMEZAKI).

Hab.: Seto (May 22). Growing on the filaments of *Hydrocoleum cantharidosmum* (MONT.) GOM. and other filamentous Cyanophyceae in the littoral belt.

This species is a fairly common alga encircling other filamentous Cyanophyceae. In every characteristic the plant agrees well with the original diagnosis.

28. *Lyngbya gracilis* RABENHORST in GOMONT, Monogr. des Oscill. 124, pl. 2, fig. 20 (1892).

Hab.: Seto (May 22; August 3). Growing on *Calothrix* sp. and *Cladophora* sp. in the littoral belt.

The plants were rarely found growing on other algae. The trichomes are 5-6.5 μ in diameter, lavender blue and not or slightly constricted at the cross walls. The cells are 2.5-6 μ in length, $1-\frac{1}{2}$ time as long as the diameter.

29. *Lyngbya sordida* (ZANARD.) GOMONT, Monogr. des Oscill. 126, pl. 2, fig. 21 (1892); UMEZAKI, Journ. Jap. Bot. 25 (9-12): 227, fig. 6 (1950).

Hab.: Seto (May 22). On *Corallina* sp. in the littoral belt.

This plant was rarely found, associated with other Cyaophycean algae on *Corallina* sp.

30. *Lyngbya semiplena* J. AG. in GOMONT, Monogr. des Oscill. 138, pl. 3, figs. 7-11 (1892); UMEZAKI, Journ. Jap. Bot. 26 (7): 204, fig. 10 (1951).

Hab.: Seto (August 3; November 1); Yuzaki (October 31). On rocks in the littoral belt.

Seto specimens have the filaments about 2 cm. high, 10-15 μ broad, and the trichomes 6-12 μ in diameter, and the sheaths 2-4 μ in thickness. Yuzaki specimens have the filaments from 0.5 cm. to 1 cm. in length, 8.5-12.5 μ in diameter, and the trichomes 6-9 μ in diameter, and the sheaths 1-3 μ in thickness. The species is common in this region.

31. *Lyngbya lutea* (AGARDH) GOMONT, Monogr. des Oscill. 141, pl. 3, figs. 12-13 (1892); UMEZAKI, Journ. Jap. Bot. 26 (7): 204, fig. 11 (1951).

Hab.: Seto (August 3, November 1). On rocks or intermixed among the filaments of *Cladophora* sp.

Yuzaki (October 31). On rocks with other Cyanophyceae in the littoral belt.

The filaments are intermixed with other Cyanophyceae among the filaments of *Cladophora* sp. or expanded on rocks, and they are 5-8 μ in diameter. The trichomes are 2.8-4.7 μ in diameter and their cross walls are often conspicuous.

32. *Lyngbya confervoides* C. AGARDH in GOMONT, Monogr. des Oscill. 136, pl. 3, figs. 5, 6 (1892); UMEZAKI, Journ. Jap. Bot. 26 (7): 204, fig. 9 (1951).

Hab.: Yuzaki (October 31); Seto (November 1). Growing on rocks of a small tide pool, in the high tide level.

This plant is a common and the largest species of this genus collected from this coast. The filaments of the present materials form a widely expanded and olive green tuft, from 3 cm. to 5 cm. in length, and 15-29 μ in diameter. The trichomes varies from 13 μ to 17 μ in diameter. Their other characteristics are typical.

33. *Microcoleus Boergesenii* (GARDNER) FRÉMY, Dansk Botanik Arkiv. 9 (7): 12, fig. 1 (1939); UMEZAKI, Journ. Jap. Bot. 27 (4): 119, fig. 17 G (1952).

Hydrocoleum Boergesenii GARDN., Sci. Surv. Porto Rico & Virgin Isl. 8 (2): 289 (1932).

Hab.: Seto (May 21). On *Ulva conglobata* KJELLM. growing in the littoral belt.

The writer has found only a single filament growing on *Ulva conglobata* KJELLM. The filament is 49μ in diameter at the broadest portion. The trichomes are light aeruginous, $6-6.6\mu$ in diameter, and densely entwined within the sheath. The cells are $1.8-2.6\mu$ in length.

For the first time, this species was published as *Hydrocoleum Boergesenii* by N. GARDNER in 1932 based on the specimen collected from the Danish West Indies by Dr. BOERGENSEN. Afterwards, *Hydrocoleum Boergesenii* was combined to the genus *Microcoleus* by P. FRÉMY in 1939, and he gave a detailed diagnosis and figure to this species.

34. *Microcoleus chthonoplastes* THURET in GOMONT, Monogr. des Oscill. 353, pl. 14, figs. 5-8 (1892); UMEZAKI, Journ. Jap. Bot. 27 (7): 221, fig. 23 (1952).

Hab.: Seto (August 3). On rocks or *Hypnea pinnosa* J. AG. in the littoral belt.

Bansho-zaki (November 1). Growing in associating with other Cyanophyceae on rocks.

The plants widely expand on rocks or other algae, and they show dirty yellowish green colour. The trichomes are mostly $2.5-4.5\mu$ in diameter, but sometimes up to 6μ . The cells measure $3.7-7.5\mu$ in length, and 1-2 times as long as the diameter.

35. *Microcoleus tenerrimus* GOMONT, Monogr. des Oscill. 355, pl. 14, fig. 9-11 (1892); UMEZAKI, Journ. Jap. Bot. 27 (4): 119, fig. 17 F (1952).

Hab.: Seto (May 22; November 2). Among the filaments of *Hydrocoleum lyngbyaceum* KUETZ. growing on rocks in the littoral belt.

Almost all the characteristics of this plant at hand are typical

36. *Microcoleus tenerrimus* GOMONT var. *longus* UMEZAKI var. nov.

Fila solitaria, aeruginea, simplicia vel parce pseudo-ramosa. Vaginae hyalinae, amplae, apice acuminatae, aut apertae, interdum omnino diffuentes. Trichomata dilute aeruginea, intra vaginam pauca, $1.5-2\mu$ crassa, apice saepius longissime attenuata; ad genicula constricta; dissepimenta pellucida, non granulata; articuli longiores quam latiores, $4-9\mu$ longi, $2.5-6$ -plo longiores quam latiores. Cellula apicalis haud capitata, acutissime conica.

Filaments solitarily dispersed among other Cyanophycean strata, aeruginous in colour, simple or sparsely pseudo-branched. Sheaths hyaline, ample, apices acuminate or open and blunt, sometimes entirely diffuent. Trichomes light aeruginous, generally 2-10 within a sheath, $1.5-2\mu$ in diameter, apices frequently long attenuate; cross walls constricted; dissepiments pellucid, not granulated; cells much longer than the diameter, $4-9\mu$ in length, $2.5-6$ times as long as the diameter. Apical cells not capitate, very acute conical.

Hab.: Seto (May 22). Among the strata of *Microcoleus tenerrimus* GOM. and other Cyanophyceae which grow on rocks in the littoral belt.

This new variety of *Microcoleus tenerrimus* GOM. is distinguished from the species by its much longer cells and containing the fewer trichomes within a sheath. — Fig 3.

37. *Hydrocoleum cantharidosmum* (MONT.) GOMONT, Monogr. des Oscill. 336, pl. 12, figs. 6, 7 (1892).

Hab.: Seto (May 22). Intermixed with other Cyanophyceae on rocks.

The filaments form an olive green, mucous stratum. The sheaths are very mucous or often diffluent. The trichomes are $18-22\mu$ in diameter, and 1-4 within the sheath. The cells are very short, $1.5-3\mu$ in length and $\frac{1}{6}-\frac{1}{10}$ time as long as the diameter. Other characteristics are typical.

38. *Hydrocoleum lyngbyaceum* KUETZING in GOMONT, Monogr. des Oscill. 337, pl. 12, figs. 8-10 (1892); UMEZAKI, Journ. Jap. Bot. 26 (9): 269, fig. 16 (1951).

Hab.: Seto (May 22; August 3). On rocks or oyster in the littoral belt.

Ka-shima (August 2). On rocks in the littoral belt.

Senjoyo-jiki (October 31). On rocks in a small tide pool in the high tide level.

The fronds are widely expanded and very mucous. The sheaths are hyaline, very mucous, often almost diffluent, and owing to its difffluence, filaments are often dispersed by slight pressure. The diameter of the trichomes is from 9μ to 15μ . This species is very commonly found in this coast.

39. *Schizothrix lacustris* A. BRAUN in GOMONT, Monogr. des Oscill. 301, pl. 6, figs. 9-12 (1892); UMEZAKI, Journ. Jap. Bot. 27 (7): 222, fig. 24 (1952).

Hab.: Seto (May 23). On rocks with other Cyanophyceae in the littoral belt.

The materials were rarely found among other Cyanophycean algae. The filaments are mostly branched at the upper portion, and up to 1 mm. in length. The trichomes are $1-1.5\mu$ in diameter and not attenuated at their end portions. The cells are up to 4μ in length, quadrate or 2-3 times longer than the diameter.



Fig. 3. *Microcoleus tenerrimus* GOM. var. *longus* UMEZAKI. Upper portion of a filament ($\times 750$).

THE RELATION BETWEEN CHLORINITY AND SILICATE CONCENTRATION OF WATER OBSERVED IN SOME ESTUARIES

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With 5 Text-figures and 1 Table

The most important problem near the estuaries may be the investigation of the influence of the sea water upon the river water and *vice versa*. By stochastic analysis of previous data, I found that the concentration of chlorine (dominant in sea water) and that of silicate (dominant in river water) alter near the estuary in a correlated manner which may be represented by a nearly exact linear formula. In this report I want to propose an actual relation formula deduced from the calculated data of 9 observations in two inlet bays, Yosa-naikai and Kojima Bay.

I wish to express my sincere thanks to Prof. Dr. D. MIYADI (Biologist) and Prof. Dr. M. ISHIBASHI (Chemist) of Kyôto University and their co-workers for their kind assistance, valuable advices and criticisms given to me.

Method, Descriptions on Stations and Results Obtained

Method: Water samples were taken from various depths at each station shown in Figs. 1 and 2 and treated immediately after the field work or in the next day. The chlorinity (‰) is determined by MOHR's silver titration method, and the silicate concentration (γ/L) by DIÉNERT-WANDENBLUCK's colorimetric method.

At the stochastic analysis of the obtained data, the sample correlation coefficient between silicate concentration and chlorinity was calculated respectively on each group of water samples which are regarded as being affected by the same river. To examine its significance, F_0 was computed setting the null hypothesis that the universe correlation coefficient (ρ) might be 0, and compared with the values in F table to find the level of significance. The

result was that the silicate concentration and chlorinity is negatively correlated to a great extent at each station. Then, for the universe regression equation, $[\text{SiO}_2] = \beta_0 + \beta_1 [\text{Cl}]$, β_0 and β_1 were estimated.

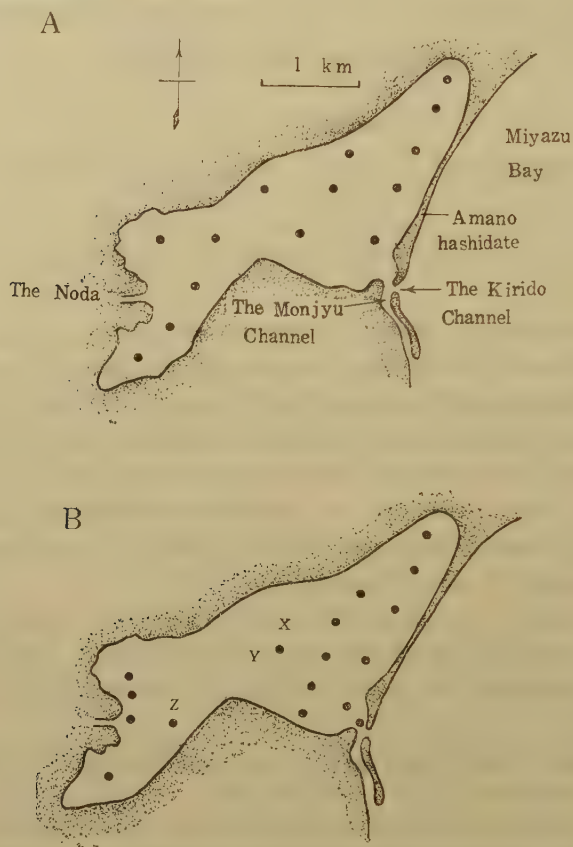


Fig. 1. Map of Yosa-naikai, showing the location of station. (A: 1950, III, 19 and V, 10-12. B: 1950, IX, 30-X, 1.) X-Y-Z indicates the location of slick observed. Water samples were taken from each side of this line.

Yosa-naikai: Yosa-naikai is a lagoon faced to Wakasa Bay of Japan Sea, just northwest of Kyôto, and is separated from the open sea by a narrow sand barrier known as "Amano-hashidate", one of the three famous sights in Japan, leaving at the south eastern corner two small canals through which the sea water flows in. The river Noda pours into the lagoon near its south western corner. My first observation was made on March 19, 1950 in the eastern part of the lagoon. The second one was performed on the whole

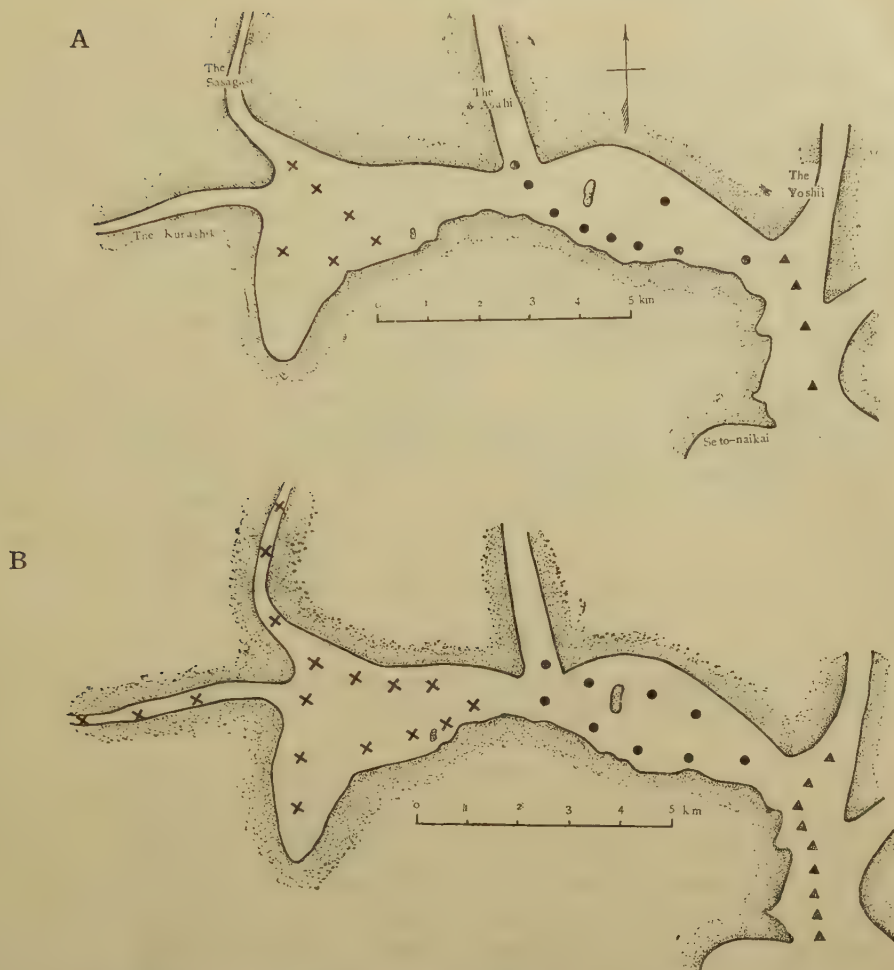


Fig. 2. Map of Kojima Bay, showing the location of stations. (A: 1951, V, 26-31. B: 1952, II, 26-27.)

- × — indicates the stations retaining the water derived from the river Sasagase.
- — indicates the stations retaining the water derived from the river Asahi.
- ▲ — indicates the stations retaining the water derived from the river Yoshii.

lagoon during the period from 10th to 12th of May, 1950. In this observation, the silicate concentration increased near the surface influenced by the river water and also near the bottom affected by the substratum. The silicate minimum layer was found at a little upper layer than the middle. Thus it may be considered very reasonable to treat the data in two groups, the shallower ones than the silicate minimum layer and the deeper ones. The non-participation ratio of the latter is larger than 0.75, and the variation of silicate concentration is relatively larger than that of chlorinity which may be able to

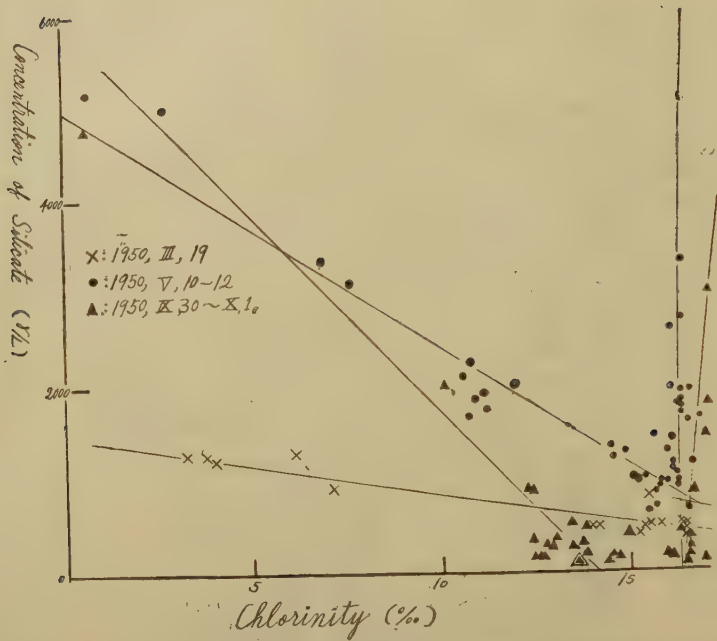


Fig. 3. Silicate-chlorine relation graph obtained by observations in Yosa-naikai. (1950, III, 19; V, 10-12; IX, 30-X, 1)

Table I.

Name of Bay	Date	Name of River	Size of Sample	r	Fo	Level of signif.	Formula
Yosa-naikai	'50, III 19	Noda	20	-0.94	148.7	< 0.01	$[\text{SiO}_2] + 62.0 [\text{Cl}] = 1470$
	'50, V 10-12		27	-0.90	110.4	< 0.01	$[\text{SiO}_2] + 256 [\text{Cl}] = 4960$
	'50, IX 30-XI		20	-0.95	189.0	< 0.01	$[\text{SiO}_2] + 417 [\text{Cl}] = 5910$
	'50, V 10-12	Deeper stagnant water	19				$[\text{Cl}] = \text{const} = 16.35$
	'50, IX 30-XI		10	0.778	12.3	< 0.01	$[\text{SiO}_2] = 2680 [\text{Cl}] - 44100$
Kojima-Bay	'51, V 26-31	Sasagase	6	-0.91	19.30	< 0.05	$[\text{SiO}_2] + 443 [\text{Cl}] = 8530$
		Asahi	22	-0.97	301.5	< 0.01	$[\text{SiO}_2] + 438 [\text{Cl}] = 7574$
		Yoshii	6	-0.995	413.5	< 0.01	$[\text{SiO}_2] + 420 [\text{Cl}] = 6962$
	'52, II 26-27	Sasagase	25	-0.975	438.8	< 0.01	$[\text{SiO}_2] + 614 [\text{Cl}] = 11280$
		Asahi	22	-0.89	77.1	< 0.01	$[\text{SiO}_2] + 463 [\text{Cl}] = 9380$
		Yoshii	11	-0.99	514.3	< 0.01	$[\text{SiO}_2] + 542 [\text{Cl}] = 10660$

be regarded as constant. Accordingly the formula for deeper, probably stagnant, water may be shown as follows: $[Cl]=\text{const.}=16.35$. The third observation was made on the whole lagoon during the period from Sept. 30 to Oct. 1950. In this case, I collected only surface and bottom samples, but none from the middle layer. So I could not ascertain the depth of the silicate minimum layer. In order to pick up the deeper stagnant water samples out of the bottom layer samples, THOMPSON's method of rejection was applied on them under 0.05 level of significance, and repeated until no sample was able to be rejected. The group of samples, thus sifted, may be considered to be of the deeper stagnant water and treated separately.

Kojima Bay: Kojima Bay is a narrow but long inlet bay situated on the northern coast of Seto-naikai, the Inland Sea, near Okayama. It is very shallow and poured by three rivers; Sasagase, Asahi and Yoshii, of which the first

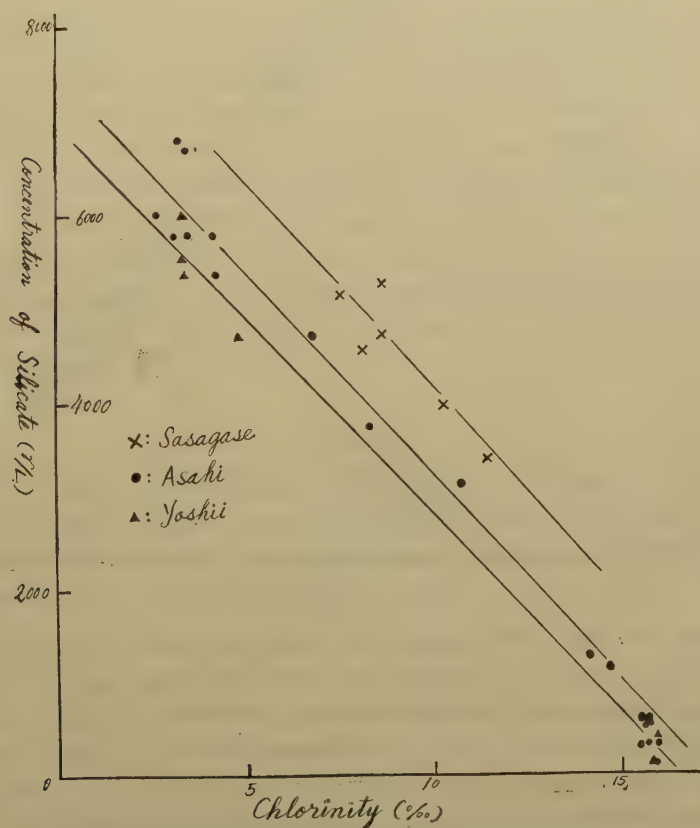


Fig. 4. Silicate-chlorine relation graph obtained by observations in Kojima Bay. (1951, V, 26-31)

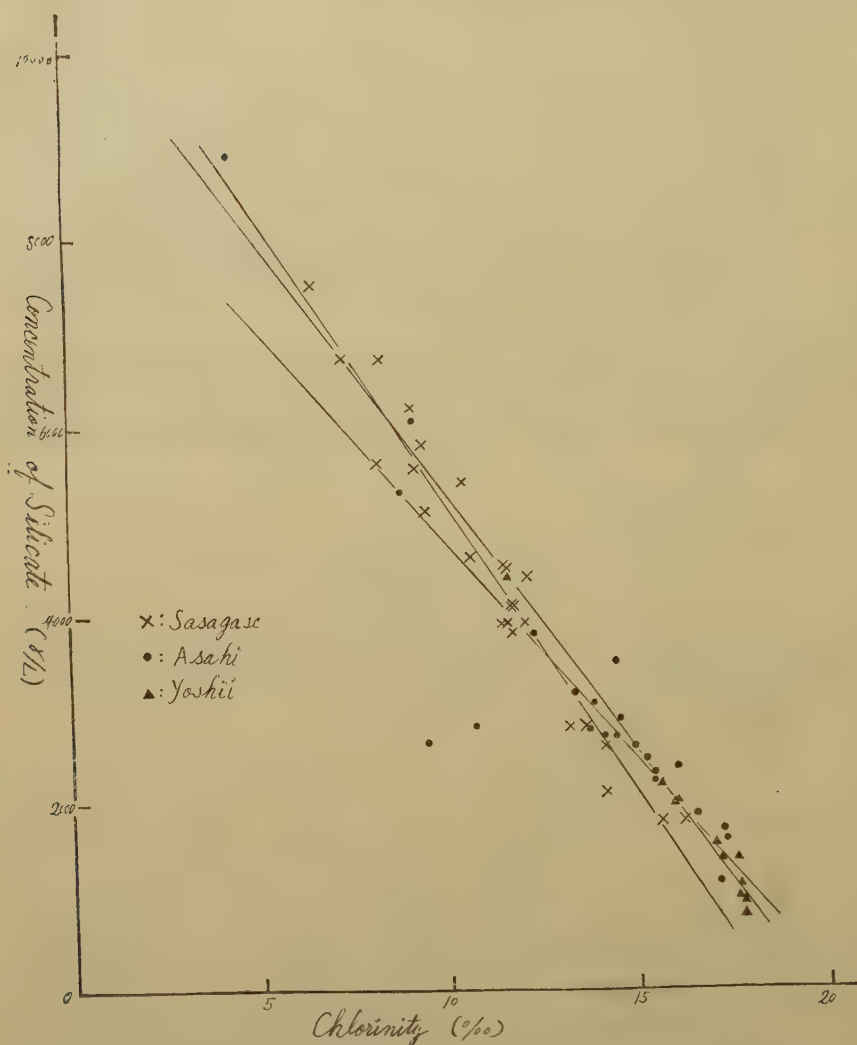


Fig. 5. Silicate-chlorine relation graph obtained by observations in Kojima Bay. (1952, II, 26-27)

one pours into the bay at the inner most part, the next at the central part of the northern coast and the last one near the mouth part of the bay. I tried the first observation during the period from 26th to 31st of May, 1951, and the second one during 26-27th of February, 1952. In both cases, water samples were divided into groups judging from the situation of sampling stations and the distribution of slicks so that the water of each sample in a group is affected respectively by the same one of the three rivers.

Discussion and Conclusion

It is clear that high chlorinity indicates the characteristic of the sea water and high silicate concentration shows that of the river or stagnant water. Near the estuary, the river water stretches widely but only in very thin surface layer; thus the influence of river and that of bottom layer are easily distinguishable from each other. The relation of chlorinity and silicate concentration in all 9 observations, mentioned above, is represented by the formula $[\text{SiO}_2] + A[\text{Cl}] = B$ with considerable accuracy. The relation found in the stagnant bottom water must be shown by the other formula, of which the direction of the projected line on graph is nearly vertical, because the chlorinity is nearly constant in the bottom layer. Thus, in the survey of the region nourished by many rivers, we may be able to distinguish the affecting area of each river one another, at first by constructing the silicate-chlorine concentration formula on each group of samples which are judged, with the aid of the observation on slicks and the consideration on the distribution of sampling stations, to be affected by the same river and next by examining whether the concentration of silicate and chlorine of any sample in the region is in the range of values estimated from one of the formulae or not.

Coefficient A and B are not constant for a river, but show seasonal or occasional changes. Moreover, formulae for different rivers are not always provided each with characteristic values of A and B. It is not impossible that some formulae for different rivers show the similar value of A, B or A and B. Nevertheless, generally speaking the above-mentioned method seems to be one of the most convenient ones to settle the affecting area of a river in the sea where it pours in.

Summary

From 9 actual observations in two inlet bays, it is clear that the relation of the concentration of chlorine and silicate near the estuaries is represented by the general formula $[\text{SiO}_2] + A[\text{Cl}] = B$ with considerable accuracy. Here, the coefficient A and B varies seasonally and occasionally.

NOTES ON SOME ANIMAL PLANKTONS COLLECTED FROM THE SEA OF JAPAN OFF SAN'IN-DISTRICT

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With a Map and 2 Tables

Several plankton samples were collected by the R.M.S. "Kuroshio-maru" of Maizuru Marine Observatory at a station in the Sea of Japan 20 miles off Kasumi, a little town in San'in district shown in the map, in May of 1951. Examining this material, I found a great number of cold water plankton ani-



mals in samples hauled from 310 m to the surface, while there were found only warm water forms living in Tsushima Current in samples hauled in the surface layer shallower than 50 m. The same phenomenon was also observed on samples collected at stations 20-30 miles off San'in district during the period from June to August in the same year.

These observations seem to suggest the existence of the flow of the so-called "inherent water of Japan Sea" under the warm water of Tsushima Current. And so, it may be very interesting to describe on the composition of zooplankton and give notes on some cold water plankton animals found during these surveys.

These plankton samples were hauled up from the deeper layer by a large closing net which was designed to catch the macroplankton living in deep water, 50 cm in diameter, 2 m in length and stretched with MÜLLER's gauze No. 5.

The composition of zooplankton will be shown in Table 1, and that of Copepoda which occupies a great part of zooplankton will be shown in Table 2.

Table 1. Composition of Zooplankton. (% to the whole zooplankton)

Station	St. 1	St. 2	St. 3	St. 4	St. 5
Lat. (N)	36-00.0	36-03.0	36-39.0	36-16.4	36-09.6
Long. (E)	134-40.0	135-13.0	135-46.0	135-27.8	134-40.0
Date	May 25	June 21	July 18	July 31	Aug. 2
Haul. Depth (m)	310-0	300-140	400-320	400-230	500-255
Hydromedusae	0.2	3.7	7.7	1.2	1.4
Copepoda	87.8	78.3	88.3	93.8	84.2
Ostracoda	3.6	0.5	—	—	8.2
Schizopoda	0.8	—	1.4	1.8	3.3
Amphipoda	0.1	0.0	0.1	1.0	1.1
Pteropoda	2.9	4.8	1.4	0.5	—
Chaetognatha	0.3	0.0	0.3	0.0	0.3
Tunicata	4.3	11.1	1.4	0.0	0.0
Others	—	1.6	—	1.7	1.5

Table 2. Composition of Copepoda. (% to the whole Copepoda)

Station	St. 1	St. 2	St. 3	St. 4	St. 5
<i>Calanus plumchrus</i>	0.3	0.6	0.3	1.3	1.4
<i>Eucalanus giesbrechti</i>	0.0	—	0.3	0.2	0.2
<i>Euchaeta japonica</i>	0.0	—	0.0	0.3	0.5
<i>Metridia lucens</i>	1.6	—	1.6	16.9	22.1
<i>Oithona</i> sp.	59.2	12.2	67.4	54.6	22.5
<i>Oncaea</i> sp.	0.0	4.3	3.1	3.9	14.2
Others	38.9	82.9	27.6	23.3	39.7

Above all, the most important species, excepting copepods, are *Aglantha digitale* HAECKEL in Hydromedusa, *Concoecia* sp. in Ostracoda, *Euphausia pacifica* HANSEN in Schizopoda, *Limacina helicina* and *Clione limacina* in Pteropoda, *Sagitta elegans* VERRILL in Chaetognatha and *Oikopleura* sp. in Tunicata. Besides the species listed in Table 2, the following species of copepods are noticeable: *Calanus cristatus* KRÖYER was found one or two individuals at three stations, *Scorechithricella minor* (BRADY) and some individuals of *Bradyidius armatus* were found at St. 5.

All of these cold water species, found commonly in the surface water of Liman Current and "Oyashio", are never seen in samples hauled up from the layer shallower than 50 m. The sample from St. 2 (off Kyôga-misaki) contains a number of warm water forms as in surface hauls, besides the cold water forms.

In the following, a brief note is given on each noticeable cold water form, although the details on Crustacea is reserved in a future paper.

a) *Aglantha digitale*, the most important species in cold water Hydromedusae in Japan, occurred always with some Siphonophora in a considerable number at all stations excepting St. 2, where no Siphonophora was found.

b) *Limacina helicina*, a cold water pteropod, was abundantly found at St. 2 in August. In other stations, it was not so matured as in St. 2, and in rather small numbers.

c) *Clione limacina*, a cold water pteropod, occurred in a few number in samples from St. 1.

d) *Sagitta elegans* was found plentifully in the deeper layer off Kasumi in May. but in August it was rather rare. In other stations, this species was found mingled with some warm oceanic species and in a few number. Some individuals fully matured, but most of them were immature. In identifying these young indi-

viduals I am indebted much to Dr. T. TOKIOKA of the Seto Marine Biological Laboratory.

Besides, the occurrence of *Oikopleura labradoriensis* LOHMANN in the deep waters near the New Yamato Bank (TOKIOKA, 1951) must be noticed.

Thus, it may be summarized safely from the above-mentioned data that the deep waters off San'in district contains many cold water animal planktons, and this phenomenon is especially remarkable at stations off Kasumi.

Before conclusion, the author wishes to express his hearty thanks to Dr. T. TOKIOKA for his valuable advices and generous help throughout this work, and also he is indebted to Mr. S. FUKASE of Nagasaki Marine Observatory, and to the crew on board the "Kuroshio-maru".

LITERATURE

- NAKAI, Z. (1942): The chemical composition, volume, weight and size of the important marine plankton, Jour. Ocean. Soc. Japan, Vol. I, Nos. 1 & 2, pp. 45-55. (in Japanese)
- TANAKA, O. (1938): Notes on *Calanus cristatus* Kröyer, Japan. Jour. Zool. Vol. VII, pp. 599-601.
- TOKIOKA, T. (1951): Pelagic Tunicates and Chaetognaths collected during the cruises to the New Yamato Bank in the Sea of Japan, Publ. Seto Mar. Biol. Lab., Vol. II, No. 1, pp. 1-25.

BRYOZOA OF 'KII PENINSULA^{1) 2) 3)}

SHIZUO MAWATARI

Research Institute for Natural Resources, Tokyo.

With Plate XII and 19 Text-figures

Last summer I had a chance to make a small collection of Bryozoa at Sugashima, Nakiri, Hamajima and Shirahama on the eastern and western coasts of Kii Peninsula. And moreover, during my stay at the Seto Marine Biological Laboratory, Dr. H. UTINOMI and Dr. T. TOKIOKA very generously placed the valuable collection of these animals in the Laboratory at my disposal and more courteously submitted a kind offer to publish my results.

I have made, on this opportunity, re-examination of many specimens on which my 1938 report is based, together with other materials obtained along the coast of the peninsula. Field notes and unpublished manuscripts are also re-examined thoroughly. And I have found 92 genera and 152 species and varieties listed up in the following table, of which 5 species and varieties seem to be new to science.

Table 1. List of species collected at the localities.

(Those with asterisks were described by SAKAKURA (1935) and not seen in materials at hand, and those in roman type are commented upon in detail in the systematic account.

Name of Species	Wakayama Pref.						Mie Pref.		
	Kada	off Wakayama	off Minabe	Tanabe	Shirahama	Tonda	Kushimoto	Hamajima	Nakiri Sugashima
ENTOPROCTA									
<i>Barentsia discreta</i> (BUSK)	+		+		+		+	+	+
<i>Pedicellina cernua</i> (PALLAS)			+		+			+	
<i>Loxosoma</i> sp.					+				

- 1) Contributions from the Seto Marine Biological Laboratory, No. 186.
- 2) Contributions from the Research Institute for Natural Resources, No. 547.
- 3) Studies on the Bryozoan Fauna of Japan and Adjacent Waters. No. 1.

Publ. Seto Mar. Biol. Lab., II (2), 1952. (Article 16)

Name of Species	Wakayama Pref.						Mie Pref.			
	Kada	off Wakayama	off Minabe	Tanabe	Shirahama	Tonda	Kushimoto	Hamajima	Nakiri	Sugashima
ECTOPROCTA										
Cyclostomata										
<i>Crisia elongata</i> MILNE-EDWARDS	+	+					+	+		+
<i>Crisia eburneo-denticulata</i> BUSK	+			+			+	+	+	
<i>Crisia cuneata</i> MAPLESTONE									+	
<i>Proboscina dichotoma</i> (D'ORBIGNY)			+						+	
<i>Entalophora proboscidea</i> (MILNE-EDWARDS)		+								
<i>Crisulipora occidentalis</i> ROBERTSON			+						+	
<i>Crisulipora iijimai</i> OKADA		+								
<i>Idmidronea atlantica</i> (JOHNSTON)		+			+					
<i>Tubulipora pacifica</i> ROBERTSON				+	+	+		+		
<i>Tubulipora pulchra</i> MACGILLIVRAY					+	+	+			+
<i>Tubulipora pulcherrima</i> (KIRKPATRICK)			+						+	
<i>Lichenopora radiata</i> (AUDOUIN)		+	+	+	+		+	+	+	+
<i>Lichenopora imperialis</i> ORTMANN					+			+		
<i>Lichenopora buski</i> HARMER								+		
<i>Lichenopora novae zelandiae</i> (BUSK)							+	+		
Ctenostomata										
<i>Amathia distans</i> BUSK	+	+	+		+	+				
<i>Bowrbankia gracilis</i> LEIDY			+						+	
<i>Vesicularia papuensis</i> BUSK							+	+		
<i>Valkeria uva</i> (LINNAEUS)			+		+	+		+		
<i>Zoobotryon pellucidum</i> EHRENBERG								+		
Cheilostomata Anasca										
<i>Aetea anguina</i> (LINNAEUS)		+		+	+	+	+	+	+	+
<i>Aetea truncata</i> (LANDSBOROUGH)				+						
<i>Membranipora tuberculata</i> (BOSC)				+	+	+		+		+
<i>Conopeum reticulum</i> (LINNAEUS)					+				+	
<i>Acanthodesia savartii</i> (AUDOUIN)		+		+	+	+	+	+	+	
<i>Acanthodesia serrata</i> (HINCKS)							+			
<i>Cupulabria guineensis</i> (BUSK)			+						+	
<i>Electra tenella</i> (HINCKS)					+		+	+		+
<i>Antropora granulifera</i> (HINCKS)			+							
<i>Aplousina filum</i> (JULIEN)	+									
<i>Crassimarginatella leucocypha</i> MARCUS			+	+		+		+		
<i>Cr. crassimarginata</i> var. <i>japonica</i> (ORTMANN)	+	+	+	+	+	+				

Name of Species	Wakayama Pref.							Mie Pref.		
	Kada	off Wakayama	off Minabe	Tanabe	Shirahama	Tonda	Kushimoto	Hamajima	Nakiri	Sugashima
<i>Tegella crenulata</i> (OKADA)	+	+	+	+	+	+		+		
<i>Tegella incrustata</i> SILÉN							+			
<i>Callopora tenuirostris</i> WATERS					+			+		
<i>Callopora canui</i> S LÉN			+		+		+	+		
<i>Ellisina albida</i> (HINCKS)				+						
<i>Ellisina canui</i> (SAKAKURA)		+	+		+	+			+	
<i>Parellisina curvirostris</i> (HINCKS)					+		+			
<i>Copidozoum planum</i> (HINCKS)			+							
<i>Hiantopora intermedia</i> (KIRKPATRICK)		+								
<i>Pyrulella corbula</i> (HINCKS)								+		
<i>Exechonella magna</i> (MACGILLIVRAY)					+			+		
<i>Flustra stolonifera</i> (OKADA)				+						
<i>Flustra papyracea</i> ELLIS and SOLANDER			+							
<i>Terminoflustra sagamiensis</i> (OKADA)				+						
<i>Spiralaria serrata</i> (MACGILLIVRAY)					+		+	+		
<i>Steganoporella magnilabris</i> (BUSK)		+	+							
* <i>Labioporella elegans</i> (SAKAKURA)	(off Kii Peninsula)									
<i>Labioporella rhomboidalis</i> sp. n.				+	+			+		
<i>Thalamoporella rozieri</i> (AUDOUIN)		+	+							
<i>Thalamoporella lioticha</i> (ORTMANN)		+	+							
* <i>Rosseliana sibatai</i> SAKAKURA	(off Kii Peninsula)									
<i>Micropora coriacea</i> ESPER			+		+			+		
<i>Monoporella nodulifera</i> (HINCKS)				+						
<i>Cellaria punctata</i> (BUSK)	+	+		+						
<i>Tricellaria occidentalis</i> (TRASK)		+	+		+			+		+
<i>Amastigia rudis</i> (BUSK)					+			+		
<i>Notoplites aviculariae</i> (YANAGI and OKADA)		+	+				+			
<i>Caberea darwinii</i> BUSK		+					+			
<i>Caberea hataii</i> OKADA			+							
<i>Caberea lata</i> BUSK	+		+		+	+	+			
<i>Caberea boryi</i> (AUDOUIN)		+								
<i>Scrupocellaria delilii</i> (AUDOUIN)		+								
<i>Scr. diadema</i> BUSK	+	+	+			+				
<i>Scr. maderensis</i> BUSK	+	+	+							
<i>Scr. californica</i> TRASK	+				+	+		+		
<i>Canda retiformis</i> POURTALES							+			
<i>Flabellaris patelliformis</i> (BUSK)	+	+								

Name of Species	Wakayama Pref.							Mie Pref.		
	Kada	off Wakayama	off Minabe	Tanabe	Shirahama	Tonda	Kushimoto	Hamajima	Nakiri	Sugashima
<i>Synnotum aegyptiacum</i> (AUDOUIN)							+			
<i>Beania magellanica</i> (BUSK)			+							
<i>Beania hexaceras</i> (ORTMANN)	+	+								
<i>Beania octaceras</i> OKADA and MAWATARI	+									
<i>Beania cupulariensis</i> OSBURN				+	+					
<i>Beania discodermiae</i> (ORTMANN)					+	+		+		+
<i>Beania mirabilis</i> JOHNSTON				+	+		+	+	+	
<i>Beania regularis</i> THORNELY					+			+		
<i>Beania intermedia</i> var. <i>kiiensis</i> n. var.					+					
<i>Dendrobeania birostrata</i> (YANAGI and OKADA)			+							
<i>Bugula dentata</i> (LAMOUROUX)				+	+		+			
<i>Bugula vectifera</i> HARMER	+	+								
<i>Bugula subglobosa</i> HARMER			+		+			+		+
<i>Bugula neritina</i> (LINNAEUS)		+		+	+					
<i>Bugula</i> sp.	+	+		+	+			+		
<i>Bugula californica</i> ROBERTSON		+								
<i>Bugula pugeti</i> var. <i>umbelliformis</i> YANAGI and OKADA		+					+			
<i>Caulibugula ciliata</i> ROBERTSON							+			
<i>Halophila johnstoniae</i> GRAY			+							
<i>Colletoria radiata</i> (MOLL)					+			+		+
Cheilostoma Ascophora										
<i>Hippothoa hyalina</i> (LINNAEUS)	+				+	+	+	+	+	+
<i>Trypostega venusta</i> (NORMAN)					+					
<i>Hippothoa divaricata</i> LAMOUROUX			+					+		
<i>Chorizopora brongniartii</i> (AUDOUIN)					+		+	+		
<i>Petralia japonica</i> (BUSK)	+	+	+		+					
<i>Petraliella armata</i> var. <i>microaviculata</i> OKADA and MAWATARI		+					+			
<i>Galeopsis pupa</i> JULLIEN			+							
<i>Schizoporella unicornis</i> (JOHNSTON)				+	+	+	+			
<i>Sch. horsti</i> (OSBURN)					+					+
<i>Sch. nivea</i> BUSK					+		+	+		
<i>Sch. kiiensis</i> OKADA & MAWATARI			+		+		+			
<i>Schizomavella auriculata</i> (HASSAL)			+				+			
<i>Sch. galeata</i> (BUSK)		+								
<i>Arthropoma cecilii</i> (AUDOUIN)			+	+	+	+	+	+		
<i>Microporella ciliata</i> (PALLAS)		+		+	+		+	+		

Name of Species	Wakayama Pref.						Mie Pref.			
	Kada	off Wakayama	off Minabe	Tanabe	Shirahama	Tonda	Kushimoto	Hamajima	Nakiri	Sugashima
<i>Fenestrulina malusii</i> (AUDOUIN)					+	+	+	+	+	+
<i>Hippodiplosia portusa</i> (ESPER)							+			
<i>Hippodiplosia pallariana</i> (MOLL.)			+							
<i>Hippoporina porcellana</i> (BUSK)		+								
<i>Eurystomella bilabiata</i> (HINCKS)						+		+	+	
<i>Erochella arcolata</i> OKADA and MAWATARI	+						+			+
<i>Erochella longirosiris</i> JULLIEN					+	+				
<i>Codonella acuta</i> (ORTMANN)	+				+		+			
<i>Cod. spatulata</i> OKADA and MAWATARI					+	+				
<i>Codonella obusata</i> (ORTMANN)		+								
<i>Smittina trispinosa</i> (JOHNSTON)	+				+					
<i>Sm. trispinosa nitida</i> (VERRILL)		+		+	+			+		
<i>Sm. trispinosa munita</i> (HINCKS)			+		+			+		
<i>Sm. aviculata</i> n. sp.					+					
<i>Sm. triangularis</i> n. sp.					+					
<i>Sm. reticulata</i> (MACGILLIVRAY)							+			
<i>Sm. collifera</i> (ROBERTSON)	+				+	+		+		+
<i>Sm. marmorea</i> (HINCKS)							+			
<i>Sm. perforata</i> OKADA							+			
<i>Sm. bella</i> (BUSK)	+	+		+	+		+	+	+	+
<i>Escharoides sauloglossa</i> LEVINSSEN			+				+			
<i>Mucronella perforata</i> OKADA		+								
<i>Mucronella takatsukii</i> OKADA		+						+		
<i>Tubucellaria cereoides</i> ELLIS and SOLANDER	+	+	+							
<i>Iodictyum axillare</i> (ORTMANN)						+				
<i>Iodictyum watanabei</i> (OKADA)	+									
<i>Sertella granulata</i> HARMER						+				
<i>Reteporella graeffei</i> KIRCHENPAUER			+							
<i>Reteporellina denticulata</i> (BUSK)		+			+					
<i>Triphylozoon bimunitum</i> (ORTMANN)		+								
<i>Triphylozoon umbonatum</i> (BUCHNER)			+							
<i>Adeona japonica</i> (ORTMANN)	+	+	+		+					
<i>Adeonellopsis hexangularis</i> (OKADA)		+	+							
<i>Mastigophora pes-anceris</i> (SMITT)							+	+		
<i>Hippopodina feegensis</i> (BUSK)			+	+						
<i>Watersipora cucullata</i> watersi MAWATARI	+			+	+	+	+	+	+	+

CALVET, 1902, p. 93; BIDENKAP, 1905, p. 44; WATERS, 1910, p. 250; WATERS, 1914, p. 853.

Zoarium repent, delicate, attaching *Bugula*, *Tricellaria*, *Scrupocellaria* and other cellularine Bryozoa with its narrow stolon. The stolon is divided at intervals into many internodes by diaphragms. The distal end of an internode dilates into a little swelling, producing, on each side a branch composed of

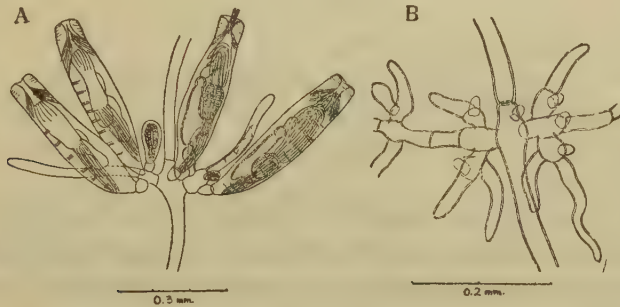


Fig. 1. *Valkaria uva* (Linnaeus) A Several functional zooecia. B A Stolon showing the mode of branching.

short internodes. The short lateral internode gives off again paired lateral branches. Zooecia arising from a vestigial internode, not crowded into a circular group, subcylindrical, more or less attenuated at the base. Orifice terminal, subquadrangular. Vestibule short, pharynx large, and gizzard not observed.

WATERS reported this species from Sudan attaching to *Petralia japonica* which is common in Japanese water. The number of zooecia in a group is rather small (4-7) in Japanese specimens.

Zoobotryon pellucidum EHRENBERG

A small colony attaching to a raft for the pearl oyster culture is obtained at Hamajima. The name of the present species is found in Miss. ROBERTSON's unpublished list of Japanese Bryozoa based on Dr. Asajiro Oka's collection at Tateyama, Chiba Prefecture.

I have another complete specimen of this species collected on the bottom of a boat at Misaki, Kanagawa Prefecture which was kindly sent to me by Dr. Katsuma DAN in 1942.

Acanthodesia savartii (AUDOUIN)

Opesia at first oval, occupying most of the frontal surface; later invaded

by a thickened and somewhat tuberculated cryptocyst in its proximal half. The proximal denticle is variable, sometimes may be merely linear and simple, but more often broad and terminated by fine teeth.

Electra tenella (HINCKS)

(Fig. 2)

Membranipora tenella HINCKS, 1880, p. 376.

Electa angulata LEVINSEN, 1909, p. 149, 156, 160; HARMER, 1916, p. 207; OKADA and MAWATARI, 1938, p. 449; SAKAKURA, 1938, p. 717.

Electra tenella MARCUS, 1937, p. 48-1938, p. 67; OSBURN, 1940, p. 356; SILEN, 1941, p. 18; OSBURN, 1947, p. 10.

Zoarium thin, delicate, brownish in colour, encrusting algae, shells, barnacles, buoys and other floating objects. Zooecia oblong, separated by shallow grooves. Opesium elliptical with a slight proximal cryptocyst. Marginal spines delicate, jointed, varying in number. Operculum with chitinized margin. A pair of strong conical spines or one only, situating on a proximal gymnocyst.

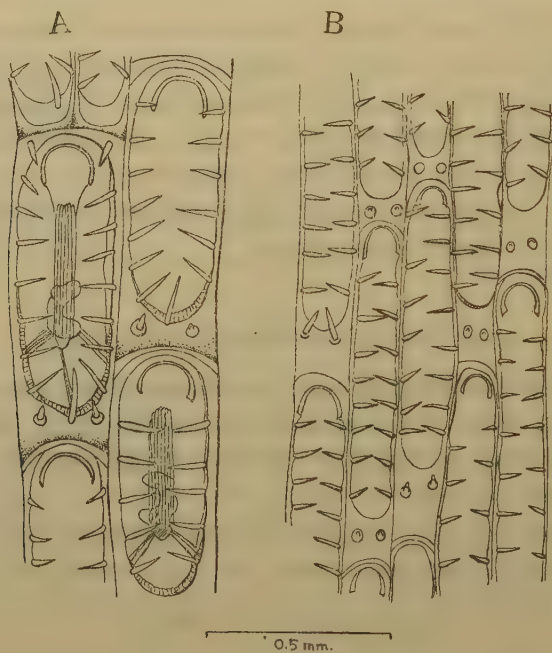


Fig. 2. *Electra tenella* (Hincks) A normal type of zooecia with narrow proximal cryptocyst. B Unusual elongate form.

Avicularia and oecia none.

HINKS figured *Membranipora tenella* as with no marginal spines, and LEVINSEN figured his *Electra angulata* as with six to twelve pairs of them. But in its description, HINKS mentioned that his *M. tenella* is sometimes provided with spines, and LEVINSEN stated that his *E. angulata* is often unarmoured. The two species described as different agree almost completely with each other in all other respects. SILEN wisely treated them as identical.

Crassimarginatella leucocypha MARCUS

(Fig. 3)

Crassimarginatella leucocypha MARCUS 1937, p. 46.

Zoarium encrusting shells. Zoecia distinct, oval, with salient margin separated by intercalated kenozoecia. Gymnocyst not developed, cryptocyst

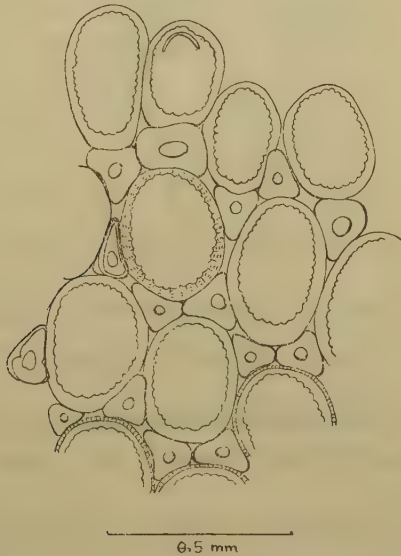


Fig. 3. *Crassimarginatella leucocypha* Marcus

granular with serrated inner margin. Opesia oval, occupying the greater part of the frontal. Kenozoecia of rounded triangle, provided with a median opening, situating on both sides of the distal end of the zoecia. Avicularia vicarious, occupying the position of one of the kenozoecia.

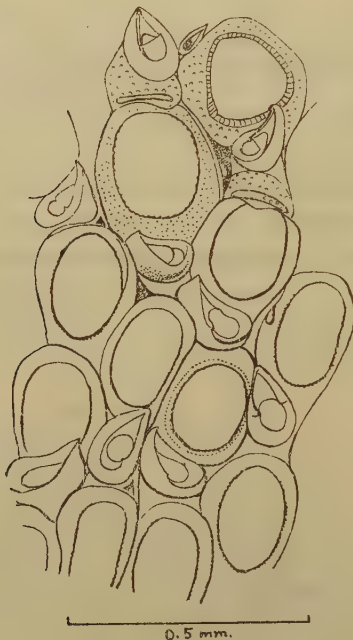
Material at hand is dead without mandibles.

Callopora canui SILÉN

(Fig. 4)

Callopora canui SILÉN, 1941, p. 34.*Callopora horrida* CANU and BASSLER, 1929, p. 103.

Several zoaria attached to stones and shells are collected. Characteristic narrow transverse fenestra is clear on the tuberculated ooecia. The shape and

Fig. 4. *Callopora canui* Silén

position of avicularium agree with the description and figure of SILÉN. A spine is observed by SILÉN on each distal corner of the zooecia, but it is not detected in the present material.

Ellisina canui SAKAKURA

(Fig. 5)

Membranipora sp. BUCHNER, 1918, p. 459.*Amphiblestrum canui* SAKAKURA, 1935, p. 6.*Ellisina canui* SILÉN, 1938, p. 273; 1941, p. 37.

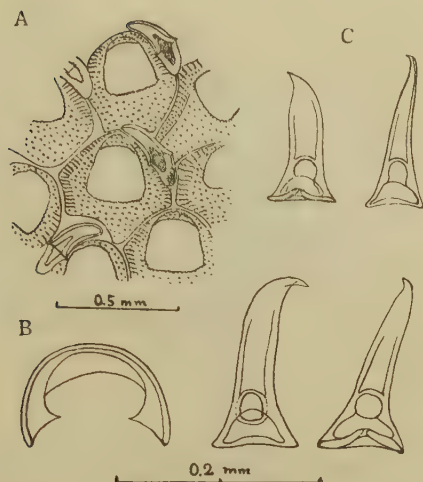


Fig. 5. *Ellisina canui* (Sakakura)
A Zooecia B Operculum C Mandibles

The materials at hand agree with the description and figures of SAKAKURA. SILÉN transferred this species to *Ellisina* on the presence of the vicarious avicularia.

Parellisina curvirostris (HINCKS)

Membranipora curvirostris HINCKS, 1880, p. 153; WATERS, 1898, p. 684; ROBERTSON, 1921, p. 46.

Callopora curvirostris CANU and BASSLER, 1925, p. 14; 1927, p. 3; 1928, p. 32.

Ellisina curvirostris HARMER, 1926, p. 228; HASTINGS, 1930, p. 711; SAKAKURA, 1935, p. 7.

Parellisina curvirostris OSBURN, 1940, p. 361; 1949, p. 4.

Exechonella magna (MACGILLIVRAY)

(Fig. 6)

Hiantopora magna MACGILLIVRAY, 1895, p. 62.

Exechonella magna CANU and BASSLER, 1929, p. 121.

Zoarium encrusting shells and stones. Zooecia large, oval or elliptical, separated by a furrow. Frontal wall much convex, thick and perforated by ten to thirty pores with salient disc-like rims characteristic of the genus. The



Fig. 6. *Exechonella magna* (MacGillivray)

structure of the frontal is quite different from that of the usual tremocyst, the true ectocyst being hidden under calcareous layer of the frontal covering. Orifice large, nearly circular or semi-elliptical with convexed proximal margin. Peristome salient and thick. Ancestrula is of the same structure with the normal autozoecium.

The material at hand is a small colony with only 14 zooecia, differing from the Philippine materials in its larger number of pores and also in the absence of avicularia, probably according to its younger condition.

Spiralaria serrata (MACGILLIVRAY)

(Fig. 7)

Membranipora serrata MACGILLIVRAY, 1869, p. 131; 1882, p. 3; 1883, p. 105.

Membranipora acifera MACGILLIVRAY, 1882, p. 2.

Membranipora acifera forma *multispinata* HINCKS, 1882, p. 465.

Spiralaria serrata LEVINSSEN, 1909, p. 123; SILÉN, 1941, p. 57.

Spiralaria spinuligera OKADA and MAWATARI, 1936, p. 53.

Zoarium encrusting, forming a thin rounded patch of brownish colour on shells. Zooecia elliptical, with large opesia of the same form. Marginal spines pointed, six to eight pairs, extending over the opesia.

Avicularia conspicuous; provided with long curved rostrum extending obliquely distally along a lateral border of the opesia of the succeeding zooecia.

The material at hand agrees well with HINKS' figure. SILÉN mentioned that *Membranipora acifera* is identical with *M. serrata*. If it be true, the present material is to be identified to *Spiralaria serrata* though it differs from SILÉN's figure in the character of the marginal spines.



Fig. 7. *Spiralaria serrata* (MacGillivray)

Labioporella rhomboidalis sp. nov.

(Fig. 8)

Zoarium encrusting stones. Zooecia elliptical or oblong, with raised edges. Gymnocyst wanting. Frontal membrane transparent, iridescent, separated by

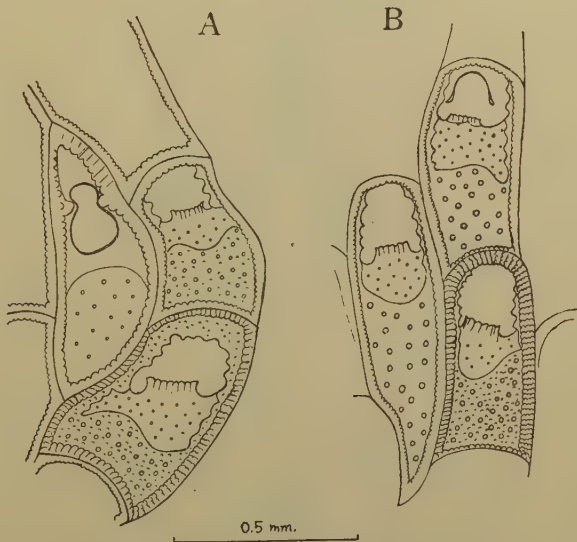


Fig. 8. *Labioporella rhomboidalis* sp. nov.

- A Aviculum and its neighbouring Zoecium.
- B Normal zobecia.

a brownish line. Tube often asymmetrical, lateral recesses distinct. Horizontal cryptocyst developed, porous, granular, occupying about a half of the frontal surface, with a somewhat wide postoral shelf, extending beyond the lateral sides of the orifice, completely round its distal border. Lateral and distal horizontal cryptocyst strongly crenulated in the region of opesia. Postoral shelf smooth, minutely punctate.

Avicularia large, rhomboidal, the proximal portion usually longer than the triangular pointed rostrum.

Avicularian opesia small, pear-shaped extending beyond the lateral condyles, the distal edge smooth, rounded. Rostral floor small, triangular.

The present new species is quite distinct among the known species of the genus in its rhomboidal avicularia.

SAKAKURA described a new species *Labioporella elegans* from Kii Peninsula. No avicularia found in his species, and avicularia rare in my material.

Micropora coriacea (JOHNSTON)

(Fig. 9)

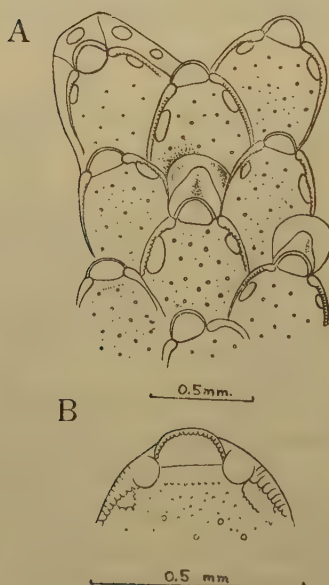


Fig. 9. *Micropora coriacea* (Johnston)

- A Zoecia and oecia
- B Orifice and opesiules

Fuadra coriacea JOHNSTON, 1847, p. 349.

Membranipora coriacea BUSK, 1854, p. 57.

Micropora coriacea GRAY, 1848, p. 115; SMITT, 1872, p. 13; HINCKS, 1880, p. 147, BUSK: 1884, p. 71; KIRKPATRICK, 1788, p. 75; MACGILLIVRAY, 1887, p. 209; WATERS, 1889, p. 16; WATERS, 1904, p. 39; ROBERTSON, 1908, p. 275; NORMAN, 1809, p. 293; CANU and BASSLER, 1920, p. 235; MARCUS, 1921, p. 101; CIPOLLA, 1921, p. 49; WATERS, 1925, p. 339; 1927, p. 8; O'DONOGHUE 1926, p. 49; HARMER, 1926, p. 307; CANU and BASSLER, 1935, p. 138; OSBURN, 1840, p. 373; OSBURN, 1947, p. 17; MARCUS, 1949, p. 16; OSBURN, 1950, p. 105.

A colony agreeing to the present species is collected off Minabe, encrusting shells. The distal half of the lateral projecting edge finely crenated. A somewhat large conspicuous tubercle on either side of the proximal margin of orifice. Opesiules distinct, asymmetrical with granular edge. Ooecia globose with broad median carina. Operculum very simple, light-coloured.

Cellaria punctata (BUSK)

(Fig. 10; Pl. XII, Fig. 6)

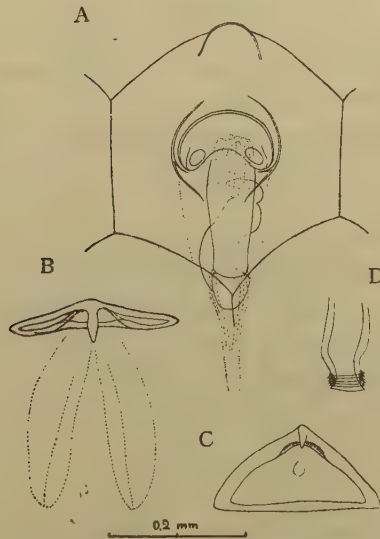


Fig. 10. *Cellaria punctata* (Busk)

- A Decalcified matured zooecium with ooecial valve, operculum, depressor sclerite and Polypide.
- B Mandible with bundles of muscles
- C Mandible
- D End of the connecting tube

Salicornaria punctata (pars) BUSK, 1852, p. 366.

Salicornaria gracilis BUSK, 1852, p. 17; 1884, p. 93.

Cellaria gracilis WATERS, 1887, p. 92; MARCUS, 1922, p. 19.

Cellaria punctata HARMER, 1926, p. 387; HASTINGS, 1832, p. 413; MARCUS, 1938, p. 206; SILEN, 1941, p. 70.

Cellaria triangularis ORTMANN, 1890, p. 32; OKADA, 1921, p. 30; 1925, p. 225; 1934, p. 11; SAKAKURA, 1935, p. 15; 1935, p. 108; OKADA and MAWATARI, 1935, p. 132; 1938, p. 350.

Cellaria japonica CANU and BASSLER, 1929, p. 171.

ORTMANN, in his original description, mentioned that his *C. triangularis* is closely related to *C. gracilis* BUSK (synonymous with *C. punctata*) but differs from it "durch verhältnismässig breitere Felder, durch undeutlich innere Leisten, durch glatten Deckel und durch längere und stärkere Internodien". These differences are insignificant, and re-examination of Japanese materials named *C. triangularis* resulted that they are all identical with *C. punctata*.

Scrupocellaria maderensis BUSK

(Fig. 11)

Scrupocellaria maderensis BUSK, 1860, p. 280; 1861 p. 77; HARMER, 1926, p. 372; HASTINGS, 1932, p. 410; SILEN 1941, p. 89.

Scrupocellaria macandrei OKADA and MAWATARI, 1938, p. 452.

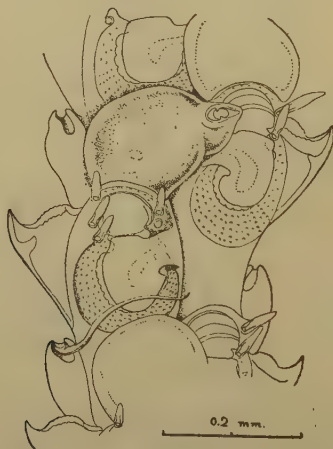


Fig. 11. *Scrupocellaria maderensis* Busk

The present material with strongly granulated cryptocyst is true *Scr. macandrei* BUSK, and it is synonymous with *Scr. maderensis* BUSK.

Beania intermedia var. *kiiensis* n. var.

(Fig. 12)

The zoarium is uniserial, not reticulate but often forming a dividing thread by the lateral branching of the zooecial series. The zooecia are recumbent, elongate elliptical with truncated distal margin. The proximal end of the zooecium, reaching the median connecting process, of the preceding zooecium is stout and short. The opesia occupy the entire front of the zooecia. No spines are seen on the opesial margin. The operculum is of the usual type without basal sclerite. The avicularia are small, paired, situating at the distal

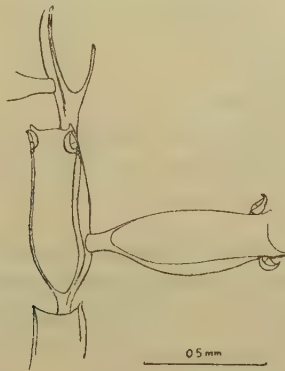


Fig. 12. *Beania intermedia* var.
kiiensis n. var.

corners of the zooecium, each carrying a small triangular mandible. The lateral connecting process is not paired, only one on each side at the level a little distally of the proximal end of the opesium. The ovicells not observed.

The present species is close to *Beania intermedia*, but differs from it in the smaller avicularia without peduncle, the truncate distal border, and smaller number of the lateral connecting processes.

Bugula sp. (undetermined)

Bugula neritina var. *minima* OKADA and MAWATARI, 1938, p. 451.

HASTINGS stated (1939 p. 336) that "Specimens have also been recorded under this varietal name (*B. neritina* var. *minima* WATERS) by OSBURN, and by OKADA and MAWATARI, but these identifications need confirmation now that the name is more strictly defined".

After re-examination, my specimen was found not belonging to *Bugula minima* thus strictly defined.

Zooecia very small, about half length of those of normal *B. neritina*, and provided with globular avicularia quite different from that of *B. minima*. The proper position of the specimen may be defined when more complete materials obtained.

Chorizopora brongniartii (AUDOUIN)

(Pl. XII, Fig. 7)

Flustra brongniartii AUDOUIN, 1826, p. 240

Leprealia brongniartii BUSK, 1854, p. 65.

Chorizopora brongniarti H NCKS, 1889, p. 224; THORNEILY, 1907, p. 183; CANU and BASSLER, 1925, p. 23; 1928, p. 29; 1930, p. 14; SAKAKURA, 1935, p. 18.

Chorizopora ventricosa CANU and BASSLER, 1929, p. 249.

The zoarium encrusts shells or barnacles, usually forming a thin silvery or grayish crust. The zooecia are delicate, pyriform or ovate separated by reticulated spaces. The frontal is an olocyst, smooth or faintly ringed transversely. Zooecial aperture is semicircular with thin peristome. A small mucro is often observed just below the orifice. The zooecium is hyperstomial, hood-like, smooth or with a median keel, usually provided with a small avicularium on its distal summit. The avicularia are not frontal but vicarious, usually one situating just distally to the normal zooecium.

The most striking feature of this species can be seen in the structure of the peculiar interzooecial networks. In many cases the zooecia seem to be bordered by a single line of small spaces between short connecting tubes, very similar to the structure observed in *Hippothoa hyalina*. Sometimes a rather wide interspace separates the zooecia, filled in by a tubular network and a number of small rounded cells frequently bearing avicularian mandibles. The small cells may be recognized as vestigial zooecia, a peculiar instance of polymorphism in the Bryozoa.

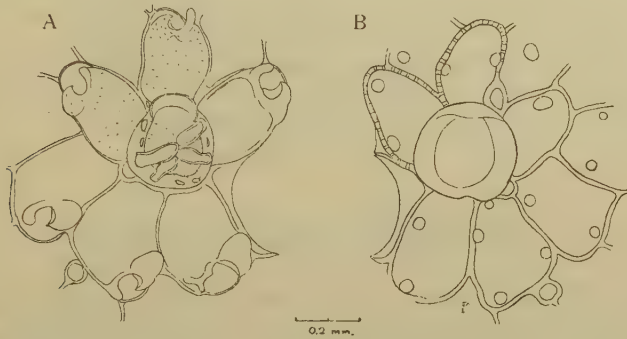
CANU and BASSLER proposed another name *ventricosa* on their Philippine materials, and described "This new species differs from *Ch. brongniartii* in its much wider zooecia with a quite different aspect". Short and wider zooecia are usually seen in many other species encrusting narrow substratum, as its main features correspond to an old species of AUDOUIN, *Ch. ventricosa* may naturally be recognized as a synonym of the present species.

Schizoporella kiiensis OKADA and MAWATARI

(Fig. 13)

Schizopodrella kiiensis OKADA and MAWATARI, 1938, p. 456.

A small colony with ancestrula is newly obtained. The ancestrula is provided with flat deformed spines extending over the opesium and meeting

Fig. 13. *Schizoporella kiiensis* Okada and Mawatari

A Peculiar ancestrula and periancestrular zooecia

B Same dorsal view

at the middle, that reminding me the formation of frontal shield of Cribrili-nidae by the fusion of costae. Two or three lucidae for attachment are seen on the dorsal side of a zooecium.

Fenestrulina malusii (AUDOUIN)

(Fig. 14)

Numerous colonies with ancestrulae are observed. The ancestrula is usually of *Membranipora* type provided with a broad, circular opesium surrounded by ten marginal spines. A single ancestrula is observed in having a normal frontal wall with ascopore, a normal aperture closed by an operculum, and a series of marginal spines of usual type. This may probably be due to the unusual survival of the ancestrular polypide, and not to the total regeneration of zooecium.

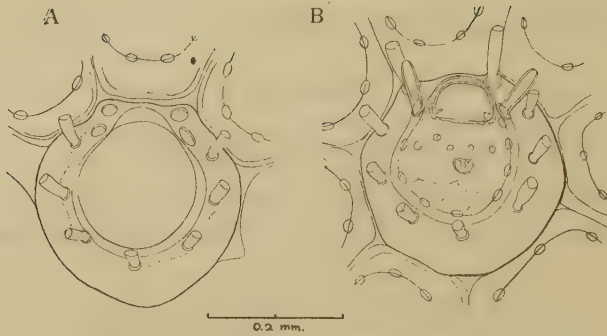


Fig. 14. *Fenestulina malusii* (Audouin)

A Usual type of ancestrula

B Ancestrula with orifice and ascopore.

Eurystomella bilabiata (HINCKS)

Lepralia bilabiata HINCKS, 1884, p. 49; ROBERTSON, 1903, p. 293, OKADA, 1929, p. 24.

Eurystomella bilabiata LEVINSEN, 1909, p. 314; CANU and BASSLER, 1923, p. 142; SAKA-KURA, 1935, p. 25.

The material at hand differs from that of Mutsu Bay in the absence of a conspicuous tubercle situated just below the aperture. Eurystomellidae was based on a single genus *Eurystomella*, in which included only two species *E. (Lepralia) foraminigera* (HINKS) and *E. (Lepralia) bilabiata* (HINCKS). LEVINSEN, who established the family and the genus, selected the former as a genotype, and was not certain to include the latter in the same genus. He mentioned that "There may possibly be reason however to form a special genus for the latter". I feel the same hesitation to put the present species in this genus, but the new name may be proposed when some allied species come into our knowledge.

Codonella obtusata (ORTMANN)

Lepralia obtusata ORTMANN, 1890, p. 41; OKADA and MAWATARI 1938, p. 457.

Smittina aviculata sp. nov.

(Fig. 15)

Zoarium encrusting or Escharine, uni- or bilameller. Zooecia quadrangular

or hexagonal, rather short, distinct, separated by a salient thread. Frontal is a granular tremocyst provided with marginal areolar pores. Orifice circular with a distinct proximal denticle and a pair of small lateral condyles. Peristome thin, raised laterally into a collar, but usually not raised on the distal end

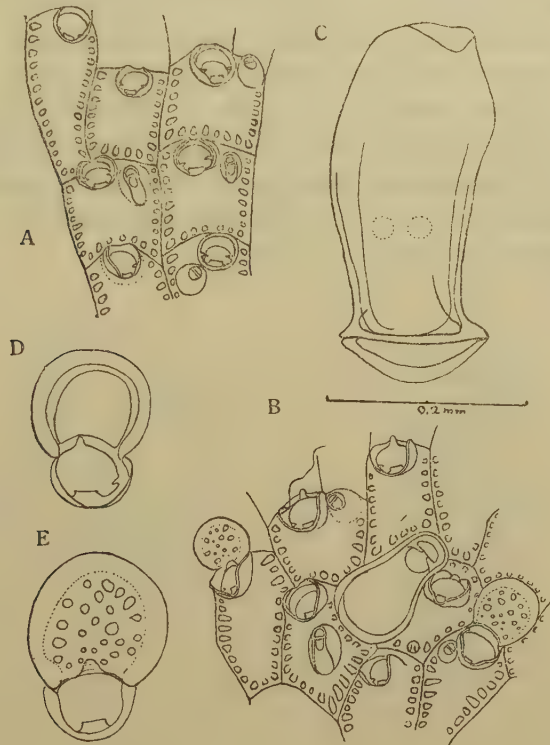


Fig. 15. *Smittina aviculata* n. sp.

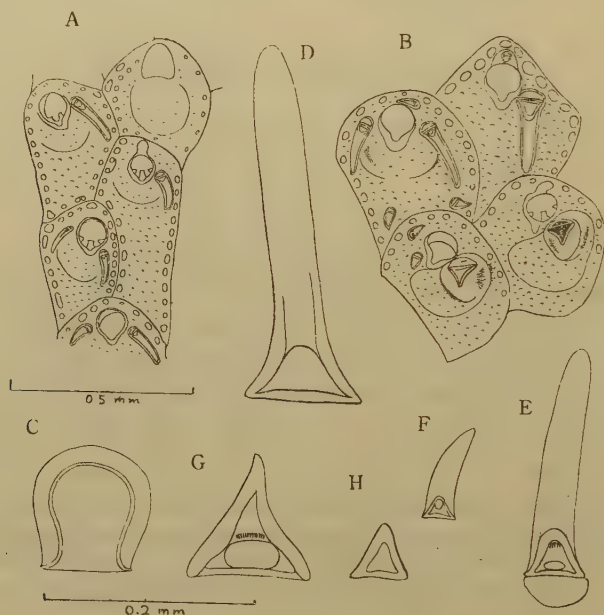
- A Normal zooecia with small semicircular and spatulate avicularia. B Enormous avicularia. C Mandible of the enormous avicularia. D, E Two stages of the development of ooecia.

of the orifice. Avicularia occur in three forms. A small rounded avicularium with semicircular mandible situates on the lateral side of the peristome. An elongated, medium-sized avicularium with spatulated mandible occur proximally or laterally to the orifice. An enormous spatulate avicularium is seen here and there in the colony, the size of which reaches almost as large as a normal zooecium. Ooecia globose with perforated frontal area.

Smittina triangulasis sp. nov.

(Fig. 16)

Zoarium encrusting. Zooecia distinct, rhomboidal or pentagonal, separated by a thread. Frontal is a granular tremocyst provided with marginal areolae. Orifice circular or of rounded triangle, with a narrow median denticle and two lateral condyles. Peristome salient, rather thin, with a proximal sinus. Avicularia are of four types. The elongated avicularia with peculiar elongated mandible situate one or two on a zooecium, laterally to the orifice directing obliquely backwards. Small avicularia with elongated triangular mandible scattered two or three in the neighbourhood of the orifice or in the proximal part of the zooecium.

Fig. 16. *Smittina triangularis* n. sp.

A Zooecia with elongate avicularia. B.C Operculum D.E Large elongate avicularia F Small elongate mandible
G Large triangular mandible.

A small triangular avicularia sometimes occurs near the orifice. Large mucronated pointed ovicularium is observed in many of the zooecia situating latero-proximally to the orifice. The triangular pointed mandible strongly chitinized and yellowish in colour. Operculum semi-elliptical with straight proximal border and submarginal sclerite.

The present species is easily distinguished in having large elongated avicularia and strong triangular avicularia.

Escharoides sauroglossa LEVINSEN 1909

(Fig. 17)

Escharoides sauroglossa LEVINSEN, 1909, p. 319.

Smittina foliacea OKADA and MAWATARI, 1938, p. 458.

In 1890 ORTMANN described *Smittia adeonelloides* from the Sagami Bay 60-200 fms., and OKADA found it from the Strait of Corea. In 1909 LEVINSEN described *Escharoides sauloglossa* from 33°7'N., 129°20'E. and 33°8'N., 129°20'E.

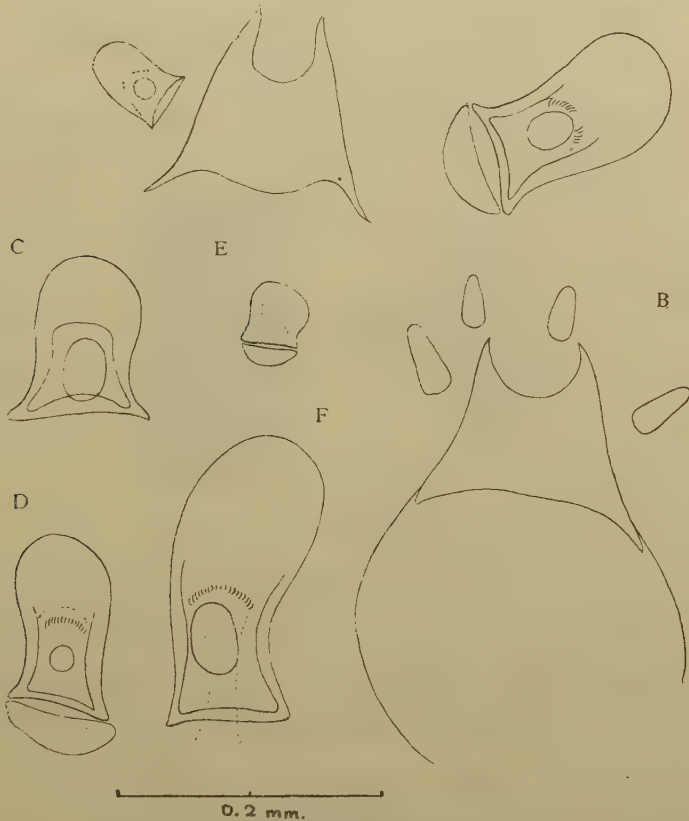


Fig. 17. *Escharoides sauroglossa* Levinsen

- A Normal position of operculum and mandibles.
- B Four spine-bases, Operculum and compensatrix
- C-F Spatulate mandibles

36-40 fms., stations just corresponding to that of OKADA's specimens. SAKAKURA believed that the two species are identical with each other.

Smittina adeonelloides is reported as an erect *Adeonella*-type branching colony, and *Escharoides sauroglossa* is described as encrusting unilamellar colony.

I have found the encrusting form occur very commonly in the littoral collection of the various parts of our country, never rising up to from erect colony. The identification to the LEVINSSEN's species is quite certain in the structure of the operculum and avicularian mandibles. The operculum and mandibles of *Smittina adeonelloides* were not figured, but mandibles is said to be pointed, in contrast to the spatulate type of *Escharoides sauroglossa*.

I am now inclined to believe the two species are not identical, and may be allied ones belonging to the same genus *Escharoides*.

Tubucellaria cereoides ELLIS and SOLANDER

(Fig. 18; Pl. XII, Fig. 2)

Tubucellaria cereoides WATERS, 1907, p. 129; OSBURN, 1914, p. 203; CANU, 1917, p. 357; CANU and BASSLER, 1928, p. 113.

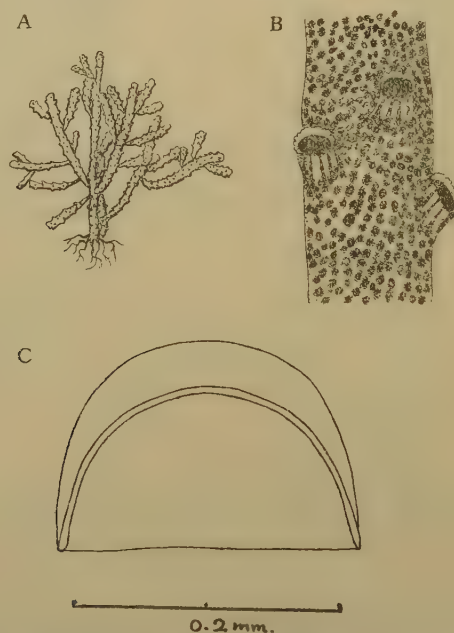


Fig. 18. *Tubucellaria cereoides* Ellis and Solander
A Articulated zoarium B Zooecia C Operculum

Tubular peristome distinctly curved upwards. Operculum semicircular with submarginal sclerite.

Adeona japonica (ORTMANN)

(Pl. XII, Fig. 1)

Adeonella japonica ORTMANN, 1890, p. 54; OKADA, 1920, p. 628

Adeona japonica CANU and BASSLER, 1927, p. 34.

Adeonellopsis hexangularis (OKADA)

Adeonella hexangularis OKADA, 1920, p. 34.

Watersipora cucullata var. *watersi* MAWATARI

Lepralia cucullata BUSK, 1854, p. 81; WATERS 1879, p. 40; 1909, p. 150.

Schizoporella aterrima ORTMANN, 1890, p. 49;

Schizoporella oenochros (nec. ORTMANN, 1890) OKADA, 1927, p. 1528; 1934, p. 12.

Dakaria typica OKADA and MAWATARI, 1937, p. 438; 1938, p. 455.

Watersipora oenochros OKADA, 1947, p. 1386.

Watersipora cucullata HASTINGS, 1930, p. 729; MARCUS, 1937, p. 118; 1938, p. 46, 110; OSBURN, 1940, p. 449; 1947, p. 40; MAWATARI, 1952, p. 14.

There has been much confusion in the systematic position of this common Bryozoa. Discussions are seen in my recent paper in 1952.

Halysisis ijimai (OKADA)

Brettia ijimai OKADA, 1921, p. 25; OKADA and MAWATARI, 1935, p. 129.

Halysisis ijimai SILEN, 1941, p. 14.

Several fragments are seen in the present collection. The species has long been known under the name of *Brettia ijimai* OKADA.

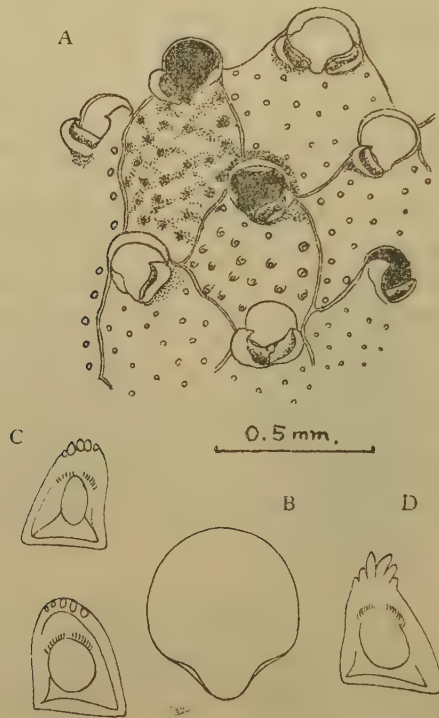
Myriozoom superficiale ORTMANN

Myriozoom superficiale ORTMANN, 1890, p. 53; OKADA, 1923, p. 231; CANU and BASSLER, 1927, p. 39.

Myriozoum serratum sp. nov.

(Fig. 19; Pl. XII, Fig. 8)

Zoarium erect, 2 cm. in height, branching irregularly in all directions. Branches cylindrical, stout, with zooecia disposed quincuncially on all sides. Zooecia distinct, rhomboidal, separated by faintly wavy septal ridges. Frontal thick, flat, punctate. Orifice circular, with a proximal sinus. Peristome not much developed. Oral avicularium, small, a little elevated, situating just on

Fig. 19. *Myriozoum serratum* n. sp.

A Zooecia B Operculum
C. D Serrated mandibles

the peristome. Mandible small, triangular with minutely serrated distal margin.

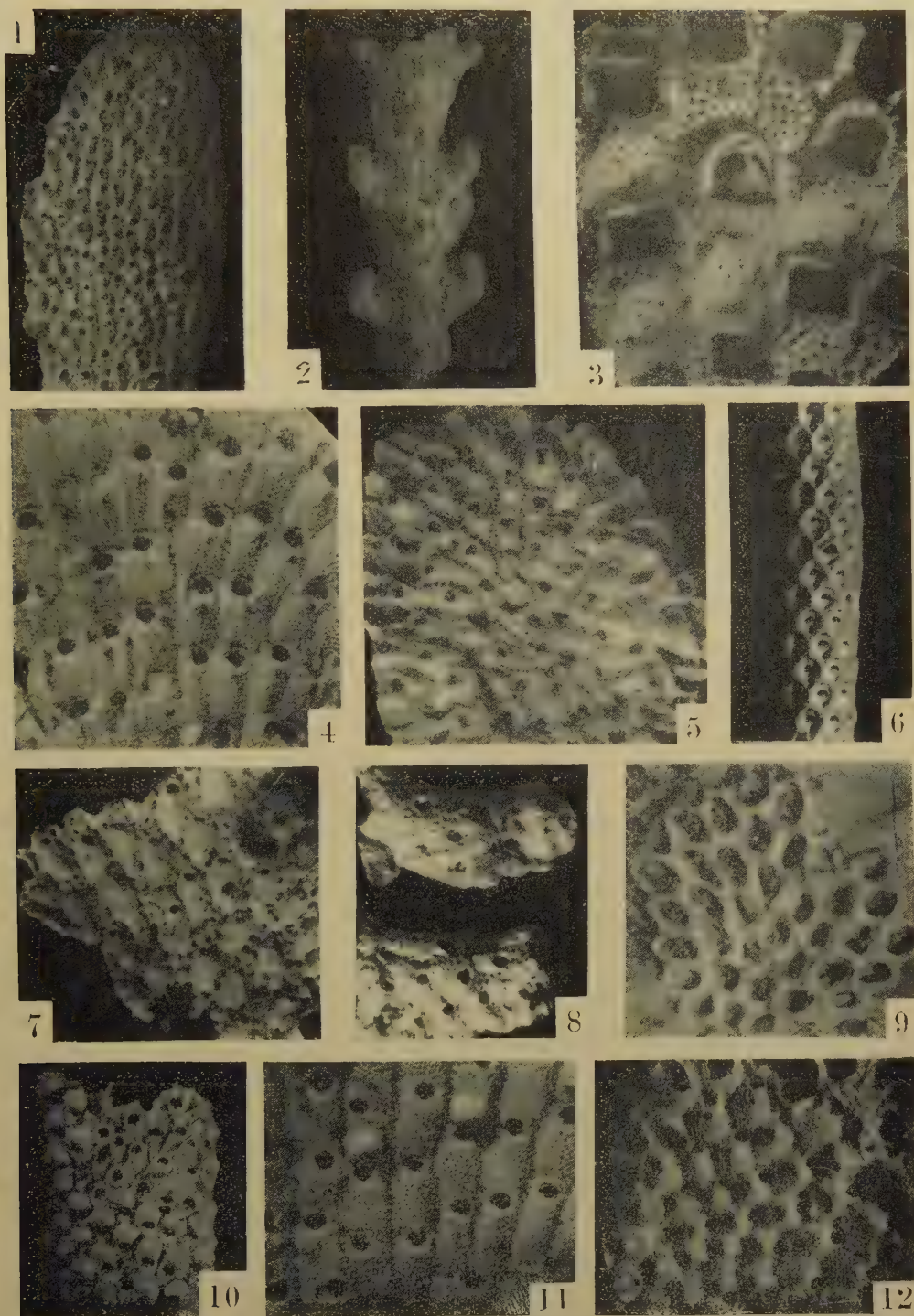
This species is closely related to *Myriozoum pulchrum* ORTMANN especially in its position of avicularia, but differs in the peculiar serrated mandibles. WATERS treated *M. pulchrum* as a synonym of *M. subgracile* D'ORIBIGNY, but I feel much hesitation to accept his determination.

LITERATURE CITED

- BUSK 1852, 1854. Catalogue of Marine Polyzoa. pt. 1, 2.
 ——— 1884. Report on the Polyzoa collected by H.M.S. Challenger. Rep. Voy. Chall., vol. 10, pt. 30.
 CANU and BASSIER 1927. Bryozoaires des îles Hawaïi. Bull. Soc. sci. Seine-et Oise, fasc. 7.
 ——— 1929. Bryozoa of the Philippine Region. U.S. Nat. Mus. Bull. 100, vol. 9.
 HARMER 1926. The Polyzoa of the Siboga-Expedition. pt. 2. Siboga-Exped. 28b.
 HASTINGS 1930. Cheilostomatous Polyzoa from the vicinity of the Panama Canal. Proc. Zool. Soc. London. 1927, pt. 4.
 HINCKS 1880. A History of the British Marine Polyzoa.
 LEVINSSEN 1909. Morphological and systematic studies on the Cheilostomatous Bryozoa.
 MARCUS 1937-1939. Bryozoários marinhos brasileiros, 1-3, Bol. Fac. Phil. Sc. Letr. Univ. S. Paulo. Zool. nos. 1, 2, 3.
 ——— 1949. Some Bryozoa from the Brazilian Coast. Com. Zool. Mus. Hist. Nat. Montevideo. vol. 3, n. 53.
 ——— 1950. Systematic Remarks on the Bryozoan fauna of Denmark. Vid. Medd. Dansk. nat. Foren. Bd. 112.
 MAWATARI 1952. On *Watersipora cucullata* (BUSK) 1. Misc. Rep. Research Inst. Natur. Res., no. 25, p. 14, 17.
 OKADA and MAWATARI 1938. On the collection of Bryozoa along the coast of Wakayama-ken. Ann. Zool. Jap., vol. 17, Nos. 3, 4.
 OSBURN 1949. The genus *Parellisina*. Allan Hancock Foundation Publ. Occ. pap. no. 10.
 ——— 1950. Bryozoa of the Pacific coast of America. Pt. 1. Cheilostomata-Anasca. Allan Hancock Pacific Expeditions vol. 14, no. 1.
 SAKAKURA 1935. Pliocene and pleistocene Bryozoa from the Bôshô Peninsula. Journ. Fac. Sci. Imp. Univ. Tokyo, sect. 2, vol. 4. pt. 1.
 SLEN 1941. Cheilostomata Anasca (Bryozoa) collected by Prof. Dr. Sixten Bock's Expedition to Japan and the Bonin Islands 1914. Ark. f. Zool., Bd. 33A, no. 12.

EXPLANATION OF PLATE XII

- Fig. 1. *Adeona japonica* (ORTMANN).
Fig. 2. *Tubucellaria cereoides* ELLIS and SOLANDER.
Fig. 3. *Petralia japonica* (BUSK).
Fig. 4. *Schizoporella unicornis* (JOHNSTONE).
Fig. 5. *Smittina reticulata* (MACGILLIVRAY).
Fig. 6. *Cellaria punctata* (BUSK).
Fig. 7. *Chorizopora brongniartii* (AUDOUIN).
Fig. 8. *Myriozoum serratum* n. sp.
Fig. 9. *Conopeum reticulum* (LINNAEUS).
Fig. 10. *Arthropoma cecilii* (AUDOUIN).
Fig. 11. *Schizoporella nivea* BUSK.
Fig. 12. *Microporella ciliata* (PALLAS).



PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

III. THE PLANKTON OF IMARI BAY IN KYUSYU*

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With 8 Text-figures

With a purpose to compare the planktonic and benthic communities of Imari Bay on the northern coast of Kyusyu with those of Nagasaki Bay on the western coast in relation to the topographical and hydrological conditions, I, conjointly with Mr. T. HABE and H. HUKUDA, made a surveying trip to these bays during the early summer of 1949. The present paper deals with the planktonological data obtained by the survey made in Imari Bay on July 12-13. The methods of survey and examining the material are similar to those used in Akkeshi Bay and the other inlets along the coast of Hokkaido (YAMAZI, 1950; 1951). The plankton samples were vertically collected from bottom to the surface by a KITAHARA's quantitative silk tow net in a small scale. The diameters of the mouth and largest part of the net are 11.25 cm and 25 cm respectively and the length is about 50 cm. So a measured quantity of water passing through the net is about 10 liters per one meter haul. The mesh of the MÜLLER's gauze is No. XX-13. The rough volume of every material was measured with a measuring tube by the settling method with 24 hours.

During the field work I was helped by Mr. T. HABE and H. HUKUDA of the Kyoto University and gentlemen of the Hatatu Fishing Guild. To all these gentlemen I wish to express my hearty thanks. My thanks are also due to Prof. D. MIYADI, Dr. H. UENOMI and Dr. T. TOKIOKA for many valuable suggestions received in preparing papers of this series.

Hydrological Conditions

Imari Bay (Fig. 1) faces the Iki Strait and lies on the northwestern coast of Kyusyu Island. It is bounded northwestwards by the cape Tusaki and

* Contributions from the Seto Marine Biological Laboratory, No. 187.

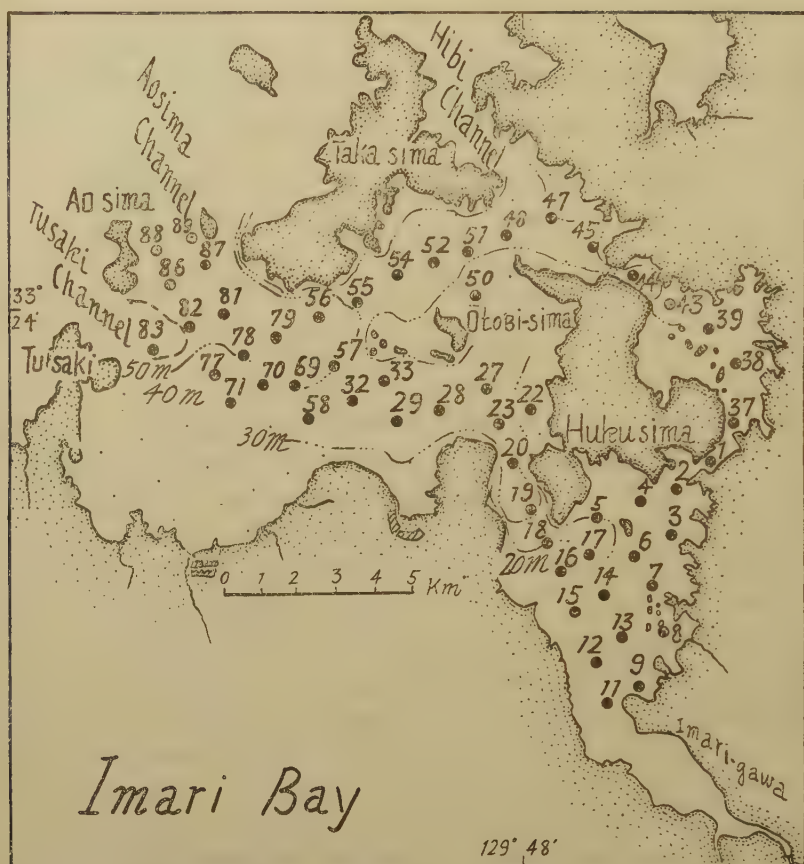


Fig. 1. Map of Imari Bay showing stations and isobaths.

northwards by several islets—Aosima, Izusima, Okonosima, Kurosima and a large island Takasima, and is connected with the Iki Strait by three narrow channels—Tusaki, Aosima and Hibi-suido which are on an average 40–50 m in depth. In the central part of the bay, there is a large island, Hukusima, which divides the bay into three regions—eastern, western and southern areas.

For convenience sake, I henceforth divide the bay into the inner and outer regions to compare the regional peculiarities, Hukusima lying on the boundary between them; thus the western area of the bay belongs to the outer region, and the eastern and southern areas to the inner region.

The only important river, Imari-gawa pours into the inner region of the bay from the south. The southern part of the inner region is relatively shallow, measuring about 6–18 m in depth. The central part of the outer region is

deeper and has the depth of about 30-40 m. The depth of more than 40-50 m is measured near the northwestern entrance of the bay.



Fig. 2. Hydrological conditions during the survey (July 12-13, 1949). I.
 A. Distribution of water temperature ($^{\circ}\text{C}$) of the superficial layer.
 B. Water temperature ($^{\circ}\text{C}$) of the 5 m layer.
 C. Chlorinity (Cl ‰) of the superficial layer.
 D. Chlorinity (Cl ‰) of the 5 m layer.
 E. pH value of the 5 m layer.
 F. Saturation degree of oxygen of the 5 m layer.

Water temperature (Fig. 2, A and B): The surface water temperature

little higher in the north (21.7–22.8°C) than in the south (22–22.7°C), and in the mouth it was higher in the west than in the east. The water temperature of the 5 m layer was lower than that of the surface (about 1–3°C), and was lower both in the mouth and northwestern part of the outer region than in the inner region. The temperature at the western half of the outer region was a little higher than at the eastern half.

Chlorinity (Fig. 2, C and D): The chlorinity of the water in the surface layer was above 18 Cl‰ near the mouth, about 17 Cl‰ in the middle of the outer region, and 11–15 Cl‰ in the inner region. The chlorinity of the 5 m layer was almost uniform (18–18.8 Cl‰). As shown in Fig. 2, D, the isohaline of 18.5 Cl‰ was in the mouth and northern half of the outer region.

Dissolved oxygen content and pH value: As shown in Fig. 2, E, the pH value of the 5 m layer was comparatively lower, being about 8.2–8.3. The pH 8.2 was widely observed in the eastern and southern parts of the inner region and the mouth part of the outer region, and pH 8.3 was only in the central area of the outer region. The dissolved oxygen content was smaller in the inner region than in the outer (Fig. 2, F). The saturation degree of oxygen of the 5 m layer was very low (87–103 %) than that of Nagasaki Bay (See No. 4 of this series).

Transparency and water color (Fig. 3, A and B): The transparency of the water was comparatively larger in the mouth and central part of the outer region, being about 6–10 m of SECCHI's disc and the water color was nos. 6–7 of FOREL's scale; the effect of pollution by sewage was hardly recognized. On the other hand, in the inner region the water showed yellowish color and less transparency (nos. 8–9 of FOREL's scale and 3–5 of the SECCHI's disc).

Phosphates (P_2O_5) and Silicates (SiO_2) contents: Those of the 5 m layer are shown in Fig. 3, C. The phosphates value varied between 30–45 mg/m³ in the outer region. The silicates were 800–1400 mg/m³ in the inner region. These substances were richer than in Nagasaki Bay. The mud temperature and texture of bottom are shown in Fig. 3, D and E.

Plankton

A. Quantitative Analysis of Plankton

The plankton samples were hauled at 49 stations (Fig. 1). The settling volume was very scarce, being less than 0.08 cc/10 liters (Fig. 3, F). It was larger in the inner region (eastern half 0.05–0.08 cc and western half 0.04 cc) than in the central part of the outer region (0.02–0.03 cc) as well as in the mouth (0.02 cc), and smallest in the southwestern part of the outer region

(0.01 cc). The settling volume was far less than that of Nagasaki Bay, owing to the scarceness of diatoms.

The total number of plankton was very small throughout all stations. The largest number was about 11 thousands per 10 liters at St. 38 in the eastern part of inner region and the smallest was about 1 thousand per 10 liters at St. 58 in the southern part of the outer region. Among 49 stations, 12 stations had the population larger than 5 thousands, 14 stations 3-5 thousands and the remaining 23 stations 1-3 thousands.

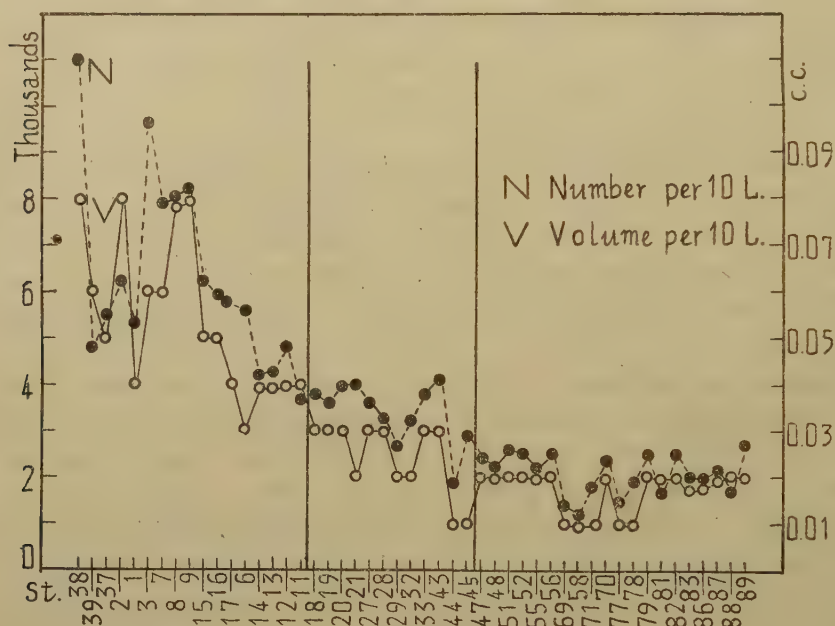


Fig. 4. Relation between the settling volume (cc) of plankton and the number of individuals, cells or colonies (each per 10 liters).

As shown in Fig. 4, the relation between the settling volume and population number per 10 liters was almost the same at all stations. It showed that the composition of population was nearly similar everywhere, excepting several stations, such as St. 1-3, 7, 37 and 38, in the eastern part of the inner region, where diatoms were found rather abundantly.

The zooplankton population (Fig. 5, B.) was found densest in the inner region, where the number reached 600-1800 per 10 liters. It generally decreased towards the eastern and central parts of the outer region (ca. 200-400 individuals) and attained the minimum in the mouth part (less than 200 individuals). The numerical percentage of zooplankton in the total plankton ($Z/N \times 100$) (Fig. 5, A) was generally large, 6-10 % in the mouth and 10-14 % in the central

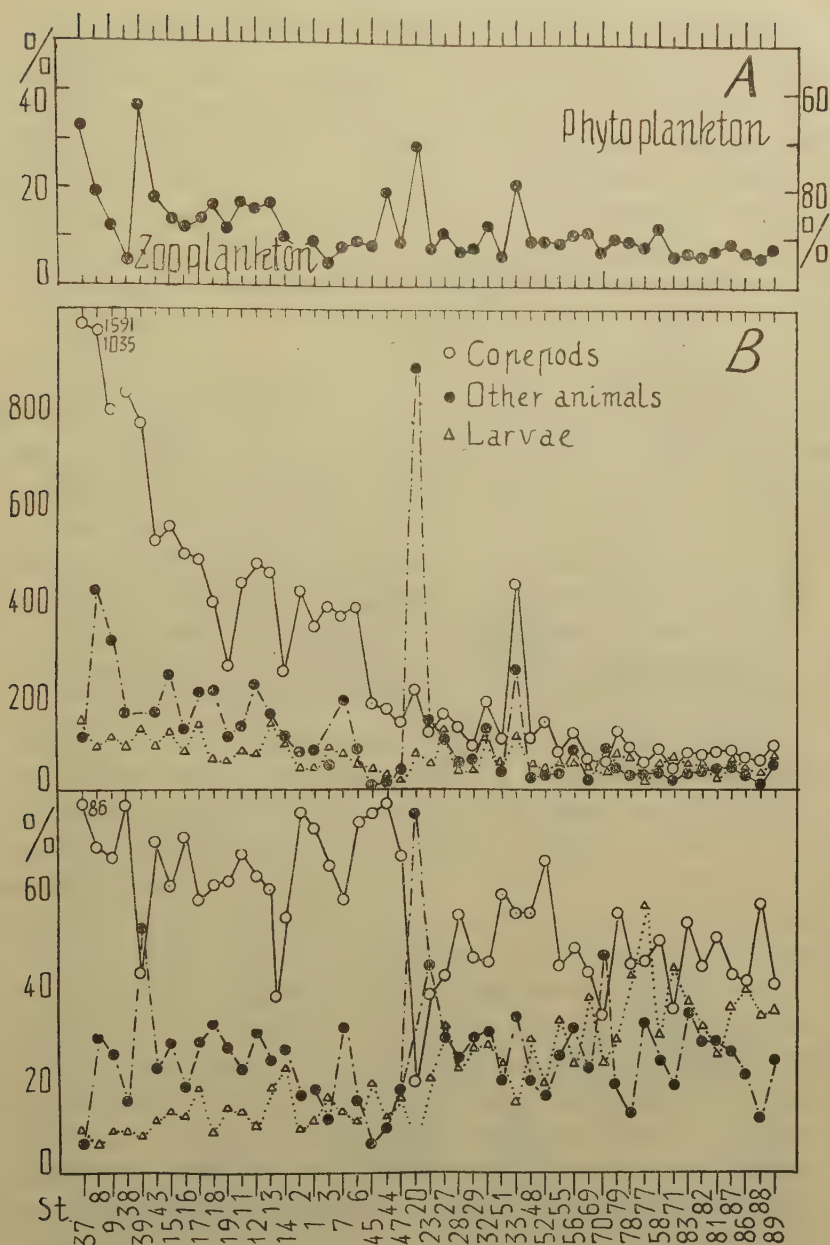


Fig. 5. A. Ratio between zoo- and phytoplankton.

B. Population of zooplankton groups per 10 liters (above) and their percentage composition (below).

part of the outer region and generally increased towards the inner region, up to 20-38 %, except at the eastern part.

The phytoplankton population was very scarce throughout the whole stations. It was fairly richer in the eastern part of the inner region, where 5-9 thousands of cells or colonies per 10 liters were counted. In the other parts they were very poor; that is, in the western half of the southern inner region were counted 3-5 thousands, in the southern half of the outer region 2.5-3 thousands, in the northern half of the outer region 2-2.5 thousands, and in the mouth 1.1-1.9 thousands. The numerical percentage of phytoplankton in the total plankton ($P/N \times 100$) was thus smaller than that of Nagasaki Bay.

B. Qualitative Analysis of Plankton

Zooplankton: As shown in Fig. 5, B, the main component of zooplankton hauled in the bay was copepod, its percentage being 40-70 %. The other animal groups, such as Protozoa, Copelata, Chaetognatha, Cladocera etc. and various larvae of animals comprising those of molluscs, polychaetes, copepods et al, were only represented by 30-60 % in the total zooplankton. Among the latter, *Noctiluca* was noticed most abundantly, while the others were very sparsely. Of the larval forms, nauplii of copepods and polychaete larvae were the most important components. The veligers of bivalves were comparatively numerous.

The main part of the zooplankton was occupied by copepods, which were distributed most abundantly in the inner region of the bay. Fig. 6 shows the number and percentage composition of main species of copepods which vary according to places. Of these species, *Oithona nana* was predominant and at the inner region it was represented by more than 85 % of the total number of copepods. Its percentage was very lower in the central and mouth parts of the outer region, showing 30 % and less than 20 % respectively. *Paracalanus parvus*, the next important copepod, was evenly distributed in the bay, but its percentage increased gradually towards the central and western parts of the outer region and attained the peak near the mouth (less than 50 %). *Oithona similis* was mainly distributed in the outer region of the bay at the frequency of 25 %, and in the inner region very sparsely, though with an increasing tendency towards the outer region. *Microsetella* and *Corycaeus* were distributed chiefly in the central and mouth parts of the outer region. No oceanic copepod was obtained during this survey.

Noctiluca, which constituted the main part of the other adult plankters, was found richer in the inner region than the outer. Other protozoans were represented by some species of Tintinninoidea, of which *Favella campanula*, *Tintinnus lusus-undae*, *Tintinnopsis radix*, *Tintinnopsis beroidea* and *Codonellopsis morchella* were sparsely found. Copelata were represented by *Oikopleura dioica*

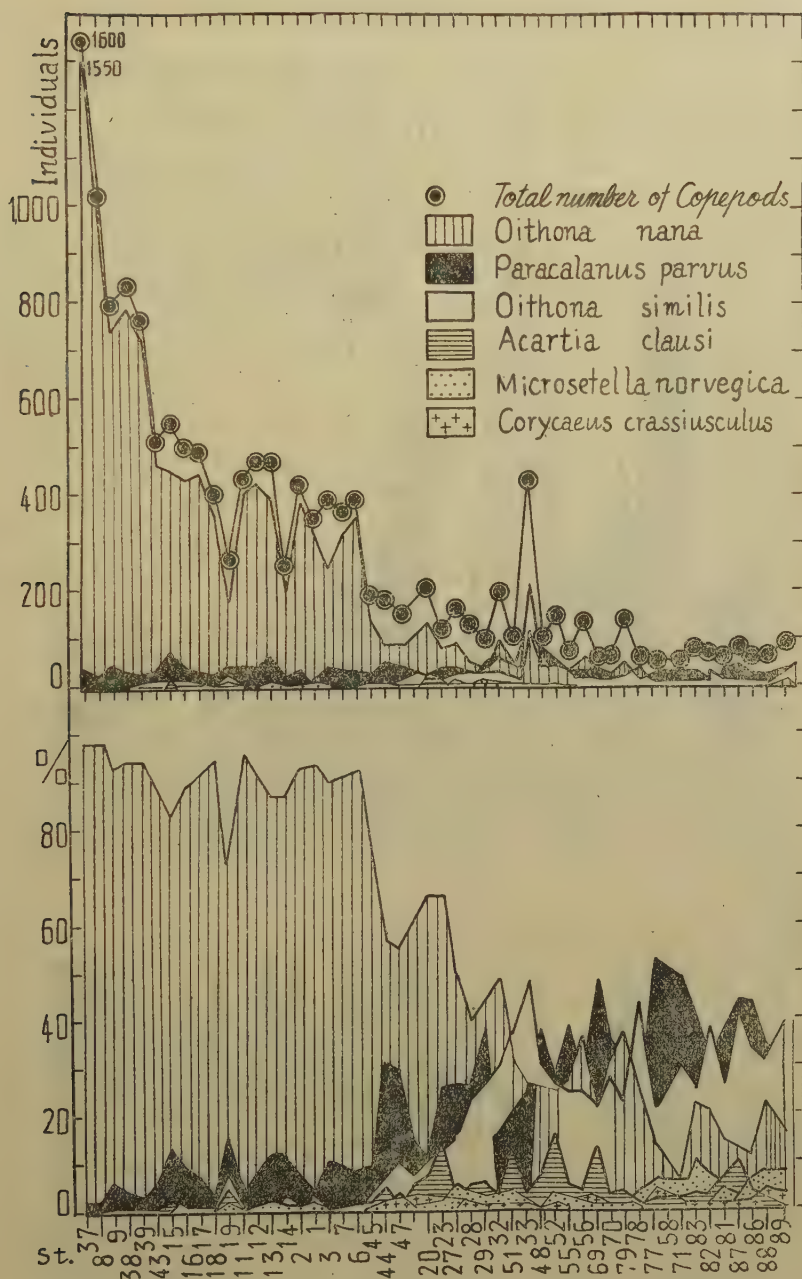


Fig. 6. Number of important copepods per 10 liters between surface and bottom (above) and their percentage composition (below).

which was distributed very sparsely, increasing in number towards the inner region. Other important zooplankters, though very sparse in occurrence, were as follows:

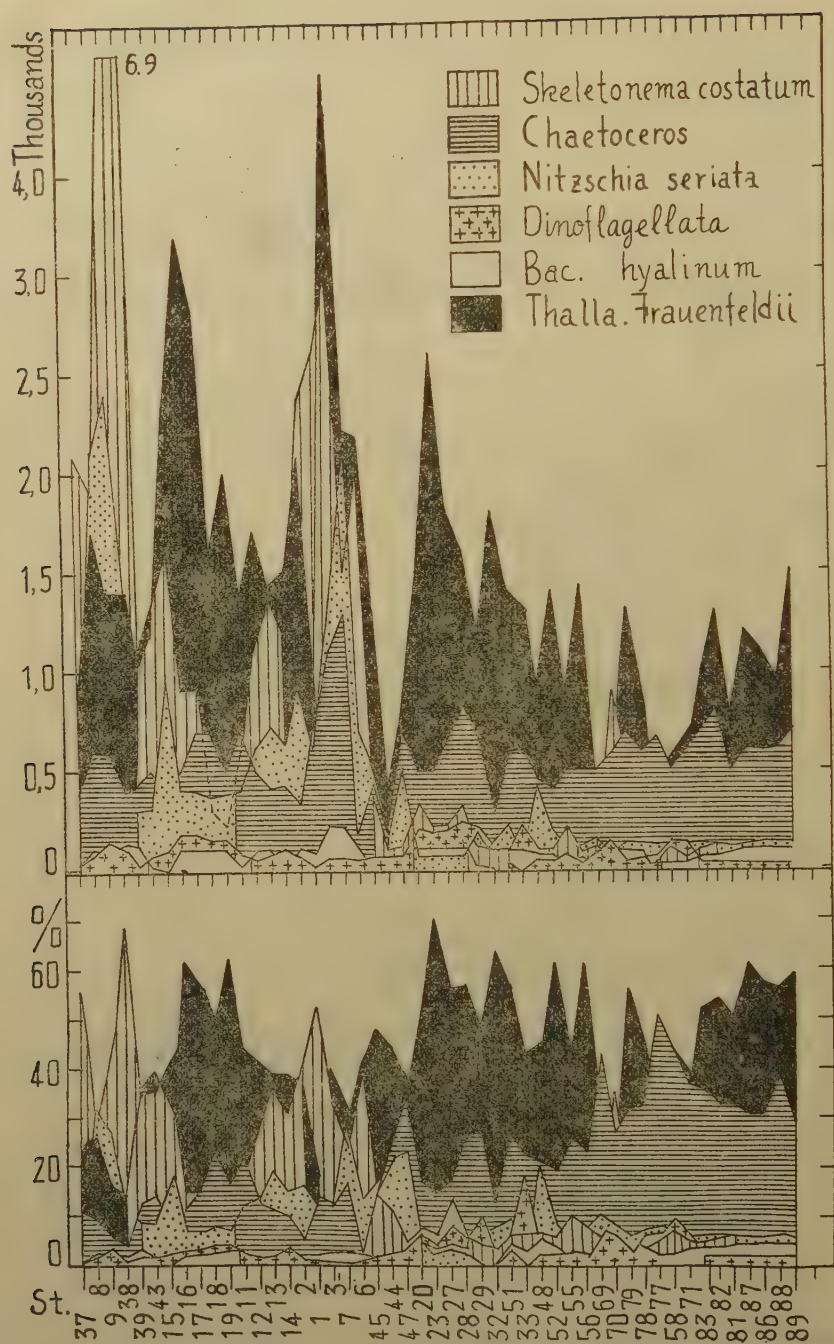


Fig. 7. Cell or colony number of important phytoplankton genera (above) and their percentage composition (below).

Species	Inner Region	Outer Region
<i>Sagitta delicata</i>	+	+
<i>Evadne nordmanni</i>		+
<i>Penilia schmackeri</i>	+	+

The main component of larval plankters was nauplii of copepods, chiefly nauplii and copepodids of *Oithona nana*, which richer in the inner region than the outer. Other important nauplii were those of *Paracalanus* and *Acartia*. The larvae of bivalves and polychaetes come next in numerical importance and were widely distributed in the bay. The former was found richer in the inner region of the bay, while the latter in the outer region.

Phytoplankton: The main components of phytoplankton are shown in Fig. 7. These composition varied according to stations in the bay. Of these *Skeletonema costatum* was abundant in the inner region, and rapidly decreased towards the outer region. *Nitzschia seriata*, another most important one in the inner region, was also distributed very sparsely in the outer region. *Thalassiothrix Frauenfeldii* was widely distributed, though rather richer in the inner region than in the outer region. *Chaetoceros* was represented by such species as *Ch. didymus*, *Ch. diadema*, *Ch. affinis*, *Ch. Lorenzianus*, *Ch. laciniosus* and *Ch. Van Heurcki*. Generally speaking, the diatoms were very sparse in the bay, so far as the survey concerned, and some of them showed different tendencies of distribution.

Among dinoflagellates, *Ceratium fusus*, *C. pennatum* and *C. inflexum* occurred in rather large numbers, being richest in the outer region near Hukusima. The first two species were found rather abundantly in the inner region, while the last one in the outer region. The other species, such as *C. macroceros*, *C. deflexum* and *C. tripos*, were evenly distributed in small numbers. These dinoflagellates may be immigrants from the open sea. The others found during this survey were as follows:

Species	Inner region	Outer region	
		eastern	western
Diatoms			
<i>Chaetoceros denticulatum</i>			+
<i>Ch. peruvianus</i>		+	
<i>Ch. decipiens</i>	+	+	+
<i>Ch. compressus</i>	+	+	+
<i>Ch. curvisetus</i>	+	+	+

<i>Coscinodiscus concinnus</i>	+	+	+
<i>Oos. Granii</i>	+	+	+
<i>Rhizosolenia alata forma indica</i>	+	+	+
Dinoflagellates			
<i>Pyrophacus horologicum</i>	+	+	+
<i>Ceratium candelabrum</i>		+	+
<i>Cer. trichoceros</i>	+	+	+
<i>Peridinium depressum</i>	+	+	+

Table I. Number of species occurred at each station.

Station Species number	Inner Region																			
	37	8	9	38	39	43	15	16	17	18	19	11	12	13	14	2	1	3	7	6
Zooplankton	16	11	14	16	14	14	10	9	11	13	12	12	12	12	13	15	15	15	14	13
Phytoplankton	23	24	23	22	20	20	12	25	21	24	21	25	22	23	25	26	21	22	22	19
Total	39	36	37	38	34	34	22	34	32	37	22	27	24	25	28	41	36	37	36	32
Mean	33																			
Total species throughout the stations	42																			

	Outer Region																			
	45	41	47	20	23	27	28	29	32	51	33	48	52	55	56	69	70	79	78	
	12	9	14	15	12	13	12	11	13	15	14	18	14	14	13	13	13	13	14	
	19	16	23	25	23	24	24	24	22	25	25	21	21	24	21	25	22	24	23	
	31	25	37	40	35	37	36	35	35	40	39	39	35	36	34	38	35	37	37	
	36																			
	46																			

											Total species
	77	58	71	83	82	81	87	86	88	89	
	13	12	13	14	12	12	13	13	12	13	24
	24	23	22	20	22	22	21	18	22	21	32
	37	35	35	34	34	34	34	31	34	34	56

Number of species: Among 56 species of plankton found during the survey, 32 species consisted almost exclusively of pelagic phytoplankters. As shown in the preceding table, the number of species did not vary greatly according to stations, though a little larger in the outer region than in the inner.

General Consideration on Regional Distribution

From available data described above, it seems clear that the distribution of plankton in the bay varies widely from place to place, depending largely on the qualitative composition of the community, and it is directly influenced by the topographical and hydrological conditions. Furthermore in inshore waters of bays and inlets, the seasonal succession of planktons is more remarkable than elsewhere. In the following I will desire to make animals, which are locally dominant or characteristic and relatively unchangeable in abundance, as indi-



Fig. 8. Distribution of dominant copepods.

cative of regional distribution. In this way the following three kinds of copepods may be recognized as indicators of plankton distribution in Imari Bay: *Oithona nana*, *Paracalanus parvu* and *Oithona similis* (Fig. 8).

1. *Oithona nana* area.

The inner region and the eastern half of the outer region of the bay were widely occupied by the *Oithona nana* association. The density of population in the inner region was very large, up to 1600 per 10 liters. According to WIBORG (1940), this species is numerous in the innermost part of Oslo Fjord. About two-thirds area of Imari Bay was dominated by *Oithona nana*. The association was characterized by the combination of large number of larval forms, especially copepod juveniles (chiefly nauplii and copepodids of *Oithona nana*) and diatoms, such as *Skeletonema costatum*, *Nitzschia seriata* and *Thalassiothrix Frauenfeldii*. It was also associated with *Paracalanus parvus* and *Oithona similis* in neighbouring area of the outer region, where they formed an inter-mixed area. *Ceratium* (i.e. *C. fusus*, *C. inflexum*, *C. pennatum*, etc.) was poor in occurrence in the inner region, but in considerable quantities outside of the island Hokusima. The animal constituents of this association were few in number, but their population was very large. Diatoms were also few both quantitatively and qualitatively, but dinoflagellates were relatively rich in species.

The water of this area was highly stagnant and colored yellowish brown with small transparency and low salinity in the surface layer, and of high values of phosphates and silicates, especially in the innermost part. This is mainly due to the pouring of river water from Imari-gawa at the head. Such environmental condition may be enough to supply rich nutrient organisms as good food for *Oithona nana* which is considered to be a detritus-eater (WIBORG, 1940, p. 21). The low pH value and low saturation degree of dissolved oxygen observed in this area may be due in part to the poorness of phytoplankton in comparison with the unusual abundance of *Oithona nana* and other zooplankton. Besides, the influence of wind direction on the distribution of salinity may not be neglected. In summer the prevailing southerly winds are apt to flow out under topographical influences. The surface water of low salinity of the inner region flows to the outer region through both narrow channels east and west of Hokusima, and overlies widely on the more saline water of the bay intruding from the open sea. This is clearly deduced from the distribution of plankton, especially in reference to the population of *Oithona nana*.

2. *Oithona similis*—*Paracalanus parvus* area.

Most of the outer region of the bay, namely the northwestern entrance and the western half of the central part, was characterized by the dominance

of two copepods *Paracalanus parvus* and *Oithona similis*, where the populations were 30-50 and 30-40 per 10 liters, respectively. Next *Microsetella norvegica*, *Acartia clausi* and diatoms such as *Thalassiothrix* and *Chaetoceros* spp. were rather abundant, though much less than the former two. The others were common to both the areas, though occurring sparsely. They are: *Euterpe acutifrons*, *Corycaeus crassiusculus*, *Noctiluca scintillans*, *Codonellopsis morchella*, *Oikopleura dioica*, *Sagitta crassa* forma *naikaiensis*, *Podon* sp., *Evadne nordmanni*, *Penilia schmackeri*, polychaete larvae, nauplii of copepods, and veligers of bivalves and snails. The number of species occurring in this area was small as in the above mentioned inner region and the population density was smaller than that of the inner region. Of dinoflagellates which formed the main component of phytoplankton, many offshore species were found in the bay. The densest population was found in the southern part of the outer region, where is the most westward extension of the *Oithona nana* area.

The water of this area was relatively stagnant and showed higher transparency and salinity, and lower water color than in the *Oithona nana* area. The high pH value (8.3) and high saturation degree of oxygen (about 100%) were observed. The eastern half of this area is combined with the northerly widespread extension of *Oithona nana* area.

Summary

In short, the Imari Bay, so far as I surveyed, seems to be characterized by the extraordinary predominance of zooplankton, in contrast to other bays or inlets in Hokkaido hitherto surveyed (YAMAZI, 1950, 1951), where phytoplankton population greatly surpassed zooplankton.

The inner region of the bay was predominated by an inshore copepod, *Oithona nana* in an extraordinary dense association, and the outer region was characterized by the mixed associations of *Oithona similis*, *Paracalanus parvus*, *Microsetella norvegica* and *Corycaeus crassiusculus*, besides *Oithona nana*. The tendency of distribution was generally similar to that in the bays and inlets hitherto surveyed. The widespread distribution of *Oithona nana* extends further outwards to the eastern half of the outer region, though less than the dominant species there in occurrence.

This may be attributed partly to the effect of the southerly direction of prevailing winds in summer, and partly to the relatively stagnant condition of the bay water. It is, however, a question whether such condition is permanent or temporary. To explain these facts, further detailed survey in other seasons is much desired.

REFERENCES

- WIBORG, K. F. 1940. The production of zooplankton in the Oslo Fjord in 1933-1934. Hvalrædets Skrifter, Nr. 21.
- YAMAZI, I. 1950. Plankton investigation in inlet waters along the coast of Japan. I. Introductory notes and the plankton of Akkeshi Bay, Hanasaki Inlet and Nemuro Harbour. Publ. Seto Mar. Biol. Lab, vol 1, no. 3.
- 1951. Idem. II. The plankton of Hakodate Harbour and Yoichi Inlet in Hokkaido. Ibid., vol 1, no. 4.

PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

IV. THE PLANKTON OF NAGASAKI BAY AND NAGASAKI HARBOUR IN KYUSYU*

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With 8 Text-figures and 1 Table

The present paper deals with the result of survey made in Nagasaki Bay on July 14, 1949. The methods of survey and examining the material are the same as those described in previous papers of this series (YAMAZI, 1950, 1951, 1952). The writer wishes to express his hearty thanks to the members of the Nagasaki Marine Observatory for their kind help offered him during the field work. This work was also made possible by a grant from the expenditure for scientific research of the Ministry of Education.

For details of general oceanographical conditions of the bay, the reader is referred to mimeographed reports published by the Nagasaki Marine Observatory.**

Hydrological Conditions

Nagasaki Bay is situated on the western coast of Kyusyu, and about 40 miles south of Imari Bay mentioned in the preceding report. It opens south-westwards to the East China Sea (Fig. 1). Nagasaki Harbour, which is well known as one of the old commercial ports in Japan, occupies the inmost part of the bay and is roughly spatulate in outline. The harbour and the bay are connected with a narrow neck about 600 m across. Several streams, such as Urugami-gawa, Iwahara-gawa and Nakasima-gawa flow into the harbour,

* Contributions from the Seto Marine Biological Laboratory, No. 188.

** YASUI, Z. et al., 1948. Report of the second oceanographical investigation of Nagasaki Harbour. Kaikyo Ryakuhō, no. 4, pp. 7-14. (in Japanese).

YASUI, Z. & YAMANO, S. 1947. Tidal currents in Nagasaki Harbour. Oceanography & Meteorology, vol. 1, no. 5. pp. 14-16. (in Japanese)

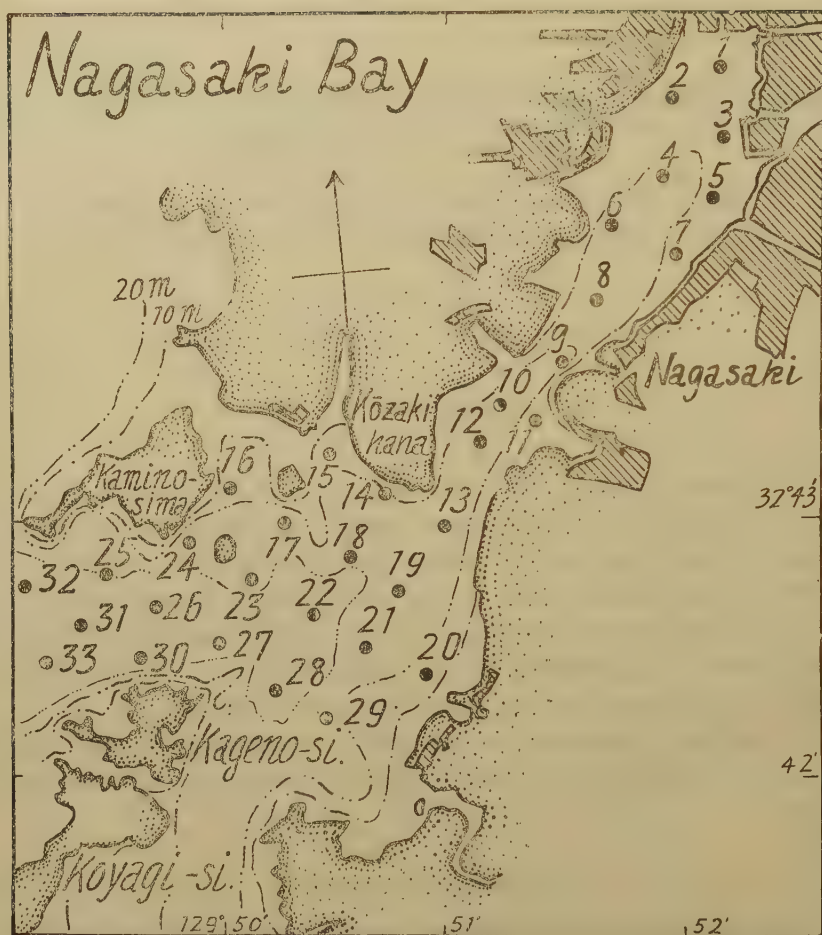


Fig. 1. Map of Nagasaki Bay showing stations and isobaths.

passing through the city of Nagasaki. The harbour is thus relatively shallow, showing the depth of about 7-16 meters. The southwestern part of the harbour is deeper, measuring about 20-30 meters in its center. The bay is guarded from the influences of the open sea by several island, such as Takahoko-sima, Nezumi-sima, Kamino-sima, Kageno-sima, and Kōyagi-sima. Owing to the inflow of the sewage, the water of the harbour shows small transparency, yellowish brown color and lower salinity in wide areas.

Water temperature (Fig. 2, A and B): The surface temperature ranged from 23.6° to 25°C, being lower near the mouth than in the northern part of the bay as well as in the harbour. In the 5 m layer, it was 22.7°-23.6°C, and a little higher in the mouth of the bay (about 22.3°-23.6°C) than in the har-

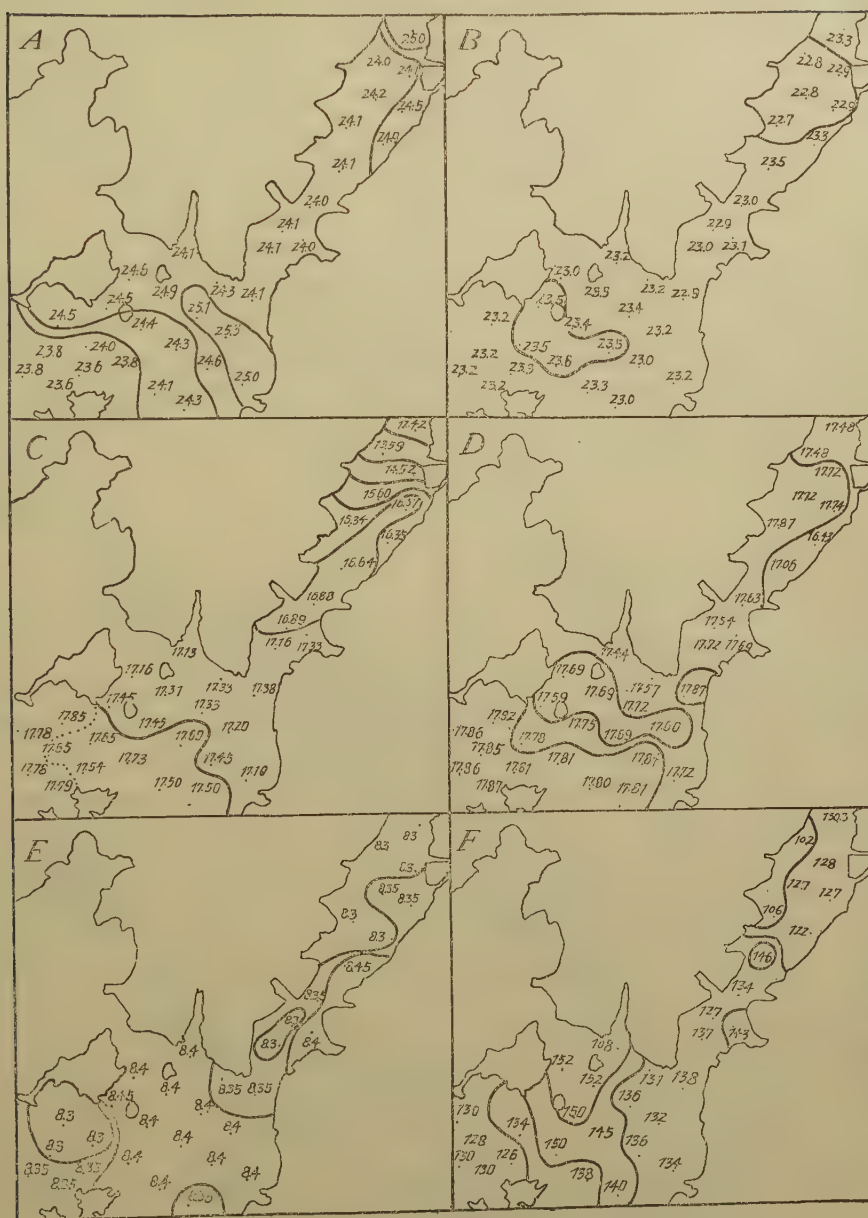


Fig. 2. Hydrological conditions during the survey (July 14, 1949). I.

- A. Distribution of water temperature ($^{\circ}\text{C}$) of the superficial layer.
- B. Water temperature ($^{\circ}\text{C}$) of the 5 m layer.
- C. Chlorinity ($\text{Cl}_{\text{‰}}$) of the superficial layer.
- D. Chlorinity ($\text{Cl}_{\text{‰}}$) of the 5 m layer.
- E. pH value of the 5 m layer.
- F. Saturation degree of oxygen of the 5 m layer.

bour (about 22.7°-23.0°C). The temperature of the bay was thus higher than that of the Imari Bay at equivalent levels, especially in the 5 m layer.

Chlorinity (Fig. 2, C and D): The chlorinity of the surface water of the bay was 17.1-17.8 Cl % near the mouth and in the central part of the bay, and 12.4-16.9 Cl % in the inner part of the harbour. The chlorinity of the 5 m layer was higher, measuring 17.6-17.9 Cl % near the mouth and in the central part of the bay, and 17-17.6 Cl % in the harbour.

pH value and dissolved oxygen content: The pH value of the 5 m layer is shown in Fig. 2, E. It was very large and constant, being about 8.3-8.4 at almost all stations, but a little lower in the innermost part of the harbour than elsewhere. The dissolved oxygen content of the 5 m layer was smaller in the innermost part than in the mouth of the harbour as well as in the bay (Fig. 2, F). Owing to the abundance of the photosynthetic plankton, the saturation degree of oxygen was very large (120-150 %), excepting a small area of the innermost part of the harbour.

Transparency and water color (Fig. 3, A and B): The transparency of the water was the smallest in the inner part of the harbour, measuring about 3-3.5 m. Owing to strongly polluted water from its surrounding city, the harbour water was very turbid, showing no. 9 of FOREL's scale. The water towards the central and the mouth parts of the bay became more transparent, measuring about 4-6 m and attained about 12 m near the mouth, where the water color was yellowish-green (no. 7 of FOREL's scale).

Phosphates (P_2O_5) and silicates (SiO_2): The phosphates and silicates contents of the 5 m layer are shown in Fig. 3, C and D. They varied between 10 and 50 mg/m³ and from 400 to 1200 mg/m³ respectively. These values are comparatively lower than those measured in Imari Bay. P_2O_5 as well as SiO_2 contents were smaller in the central part of the bay (11-20 mg/m³ of P_2O_5 ; 450-800 mg/m³ of SiO_2) and in the mouth (22-27 mg/m³ of P_2O_5 ; 380-550 mg/m³ of SiO_2).

The mud temperature and the texture of bottom samples are shown in Fig. 3, E.

Plankton

A. Quantitative Analysis of Plankton

The plankton samples were hauled at 32 stations (Fig. 1). The settling volume of plankton (Fig. 3, F) was much larger in the bay than in the harbour. It was 0.6-0.9 cc per 10 liters in the northern and southern part of the bay, 0.3-0.4 cc in the central and 0.5-0.8 cc near the mouth. It was found small-

est in the innermost part of the harbour. Owing chiefly to the richness of diatoms, the volume of plankton was much larger in this bay than in Imari Bay (YAMAZI, 1952).

The plankton population was very large throughout all stations. The largest number obtained was 280 thousands per 10 liters at St. 1 and 4; 5 stations had the population larger than 200 thousands; 7 stations 150-200 thousands; 18 stations 100-150 thousands.

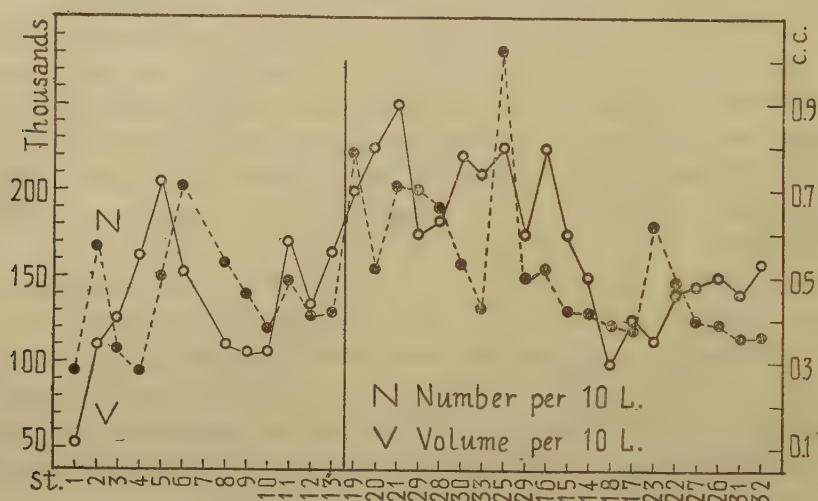


Fig. 4. Relation between settling volume (cc) of plankton and the number of individuals, cells or colonies (each per 10 liters.)

As is shown in Fig. 4, B, the relation between the settling volume of plankton and the total number of individuals, cells or colonies is never parallel. This fact implies the presence of remarkable variations in the plankton composition of different parts of the bay.

The population of zooplankton was found densest in the innermost part of the harbour and in the northern part of the bay, where the number of zooplankton reached 600-1800 per 10 liters, but it was much smaller in the mouth and the central part of the bay. The numerical percentage of zooplankton in the total plankton ($Z/N \times 100$) was very small, less than 0.3% in the mouth of the bay, and generally increased towards the innermost part of the harbour (about 1.1 %) (Fig. 5, A).

The phytoplankton was the densest in the northern and southern parts of the bay as well as in the central part of the harbour, where 150-280 thousands of cells or colonies were found. It was the thinnest in the agitated area near the mouth of the bay and also in the polluted area in the inner-

most part of the harbour. The numerical percentage of phytoplankton in the total plankton ($P/N \times 100$) appeared quite large in the mouth (more than 99.7 %) of the bay and decreased towards the inner region and attained 98.9 % in the innermost part of the harbour.

The bay as well as the harbour is thus characterized by the rich productivity of diatoms in wide areas (from the innermost part of the harbour to the mouth of the bay).

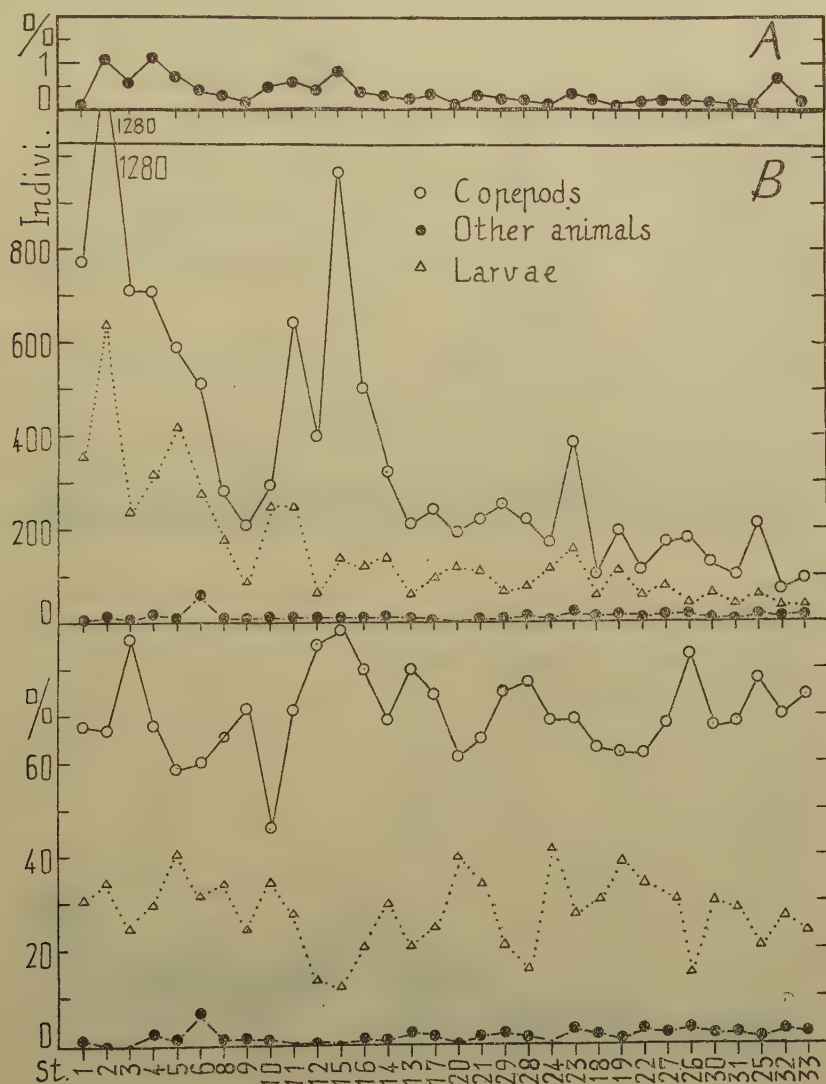


Fig. 5. A. Ratio between zoo- and phytoplankton.
B. Population of zooplankton groups per 10 liters (above) and their percentage composition (below).

B. Qualitative Analysis of Plankton

Zooplankton: As is shown in Fig. 5, B, the main part of zooplankton of the bay and the harbour, so far as the present investigation concerned, was

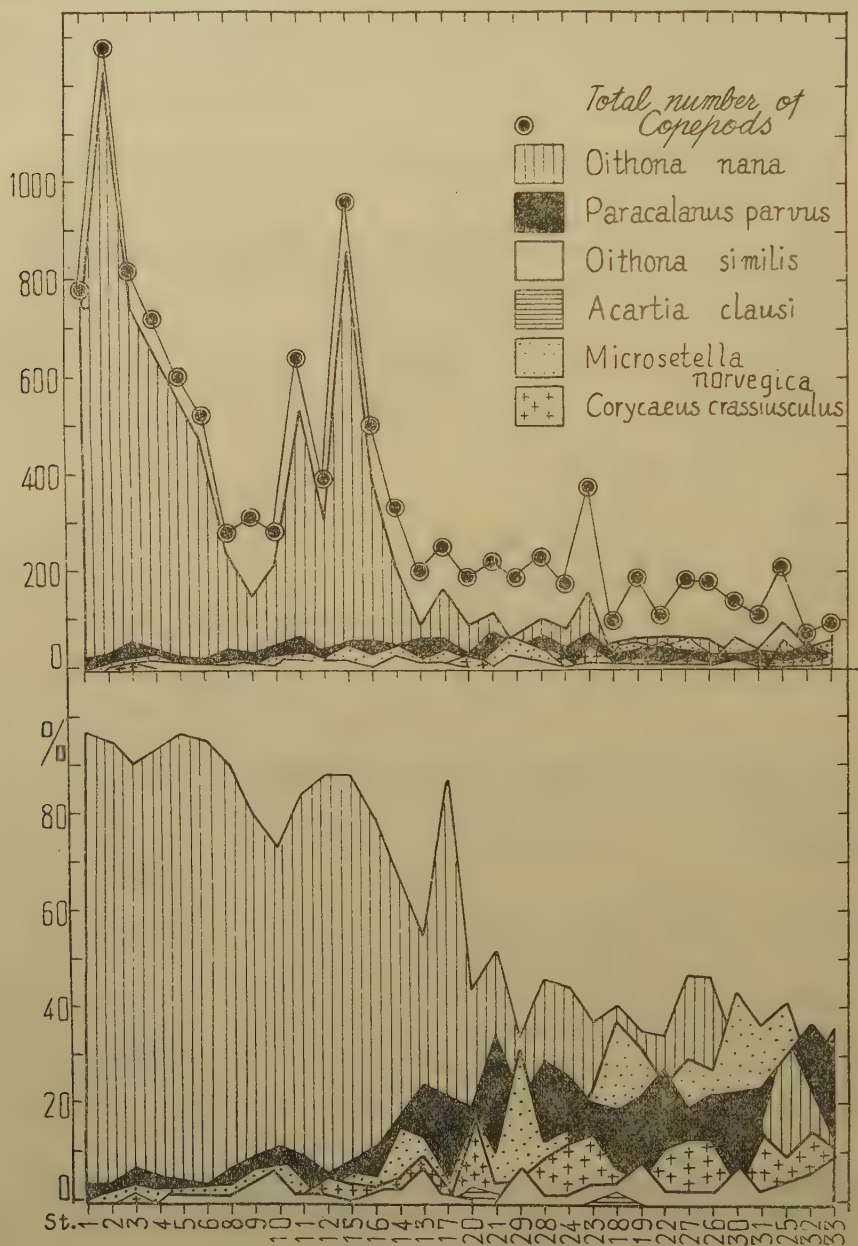


Fig. 6. Number of important copepods per 10 liters between surface and bottom (above) and their percentage composition (below).

occupied by copepods at the frequency of 60-90 %. The other animal groups including Protozoa, Chaetognatha and Copelata were only less than 3 % in the percentage composition. The larval forms, such as nauplii of copepods and cirripeds and veligers of molluscs, were represented by 15-40 % in total zooplankton.

Fig. 6 shows the number and percentage composition of the main species of copepods. As in the case of Imari Bay (The third report of this series), the main components of copepods in this bay and harbour are similar. However, a slight dissimilarity in the percentage composition could be found. *Oithona nana* was predominant and observed most abundantly in the innermost part of the harbour. Its percentage reached more than 80 % at the interior of the harbour and in the northern part of the bay, but decreased gradually outwards, and attained the minimum at the mouth of the bay (15-23 %). *Paracalanus parvus* and *Microsetella norvegica* were evenly distributed in the bay in moderate numbers, though the percentage of both species increased gradually outwards, from the inner part of the harbour (3-5 %) to the mouth of the bay (35-40%). *Oithona nana* and *Corycaeus crassiusculus* showed a rather uneven distribution at the frequency of 1-9 %; they were more abundant in the bay than in the harbour, except in the innermost part of the harbour, where they were absent. No oceanic copepod was observed during this survey.

Among tintinnoids, *Tintinnopsis radix*, *Tintinnopsis beroidea* and *Tintinnus lusus-undae* were frequent, but very sparsely found in the harbour. The typical inshore chaetognaths *Sagitta delicata* and *S. crassa* forma *naikaiensis* were widespread in the bay as well as in the harbour, though in small numbers.

The main components of larval forms were the veligers of bivalves and the nauplii and copepodids of *Oithona nana*. They were most abundant in the harbour and the northern area of the bay. Other species found in the samples are listed as follows:

Species	Nagasaki Harbour	Nagasaki Bay
<i>Centropages</i> sp.		+
<i>Eutерpe acutifrons</i>	+	+
<i>Oncaea venusta</i>		+
<i>Radiolaria</i> spp.		+
<i>Polychaeta</i> larva	+	+
Nauplii of Cirripedia	+	+
<i>Eradne noramanni</i>	+	+
<i>Podon</i> sp.	+	+
<i>Penilia schmackeri</i>	+	+
<i>Ophiopluteus</i>	+	+

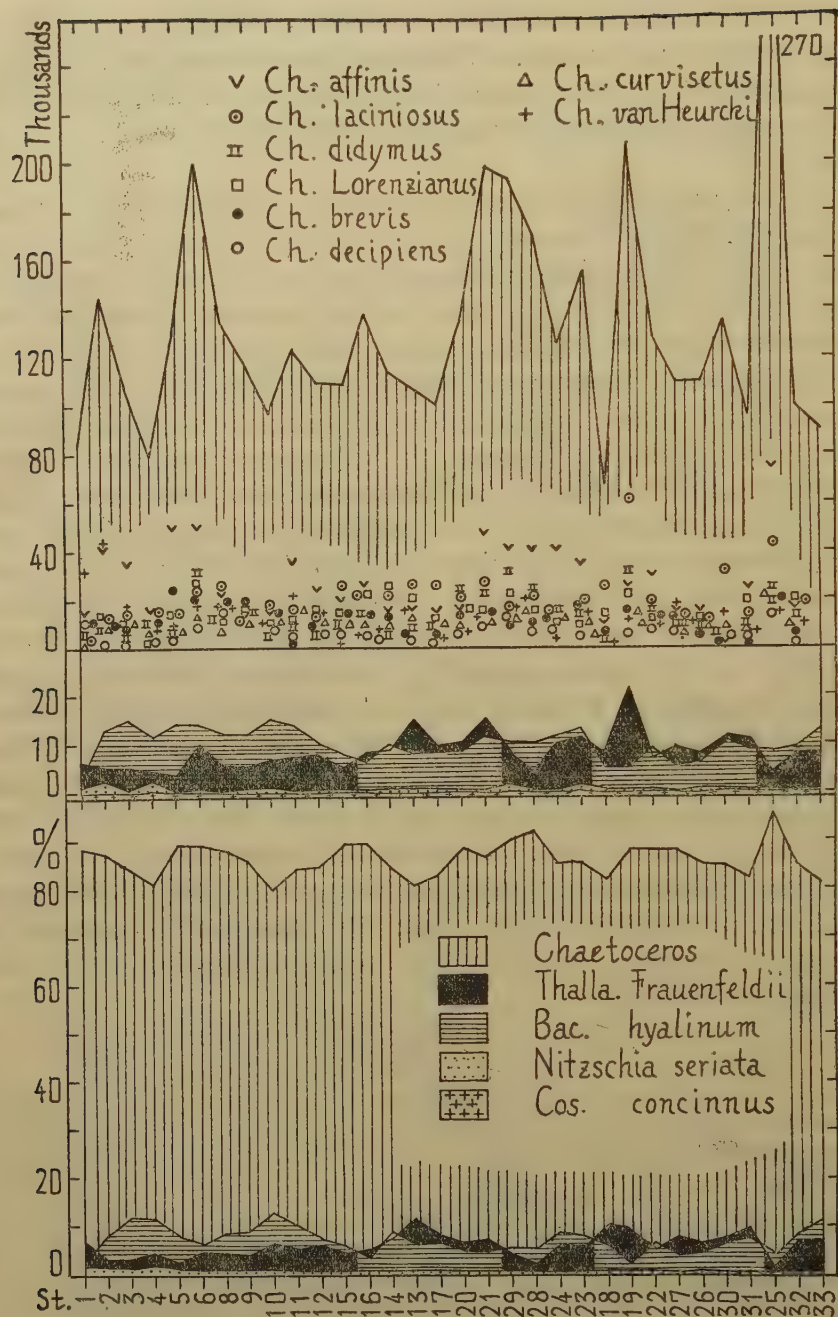


Fig. 7. Cell or colony number of important phytoplankton genera (above) and their percentage composition (below).

Phytoplankton: The leading diatom was *Chaetoceros*, of which 13 different species were recognized. Among the species, *Ch. affinis*, *Ch. laciniosus*, *Ch. Lorenzianus* and *Ch. didymus* were the predominants. The population density of *Chaetoceros* had its maximum in the bay and its minimum in the innermost part of the harbour. *Thalassiothrix Frauenfeldii*, *Bacteriastrum hyalinum*, *Nitzschia seriata* and *Coscinodiscus concinnus* were also important in the frequency of occurrence (Fig. 7). *Skeletonema costatum*, which was frequently recorded in the inner region of Imari Bay, was found neither in this bay nor harbour.

A dinoflagellate, *Ceratium furca* occurred in significant abundance in the central (St. 4) of the harbour and in the innermost part of the bay (St. 16 and 17). The distribution type of this species was similar to that of Imari Bay (YAMAZI, 1952, a). The other plankters found in the material were as follows:

Species	Nagasaki Harbour	Nagasaki Bay
Diatoms		
<i>Cerataulina bergonii</i>	+	+
<i>Lauderia annulata</i>	+	+
<i>Stephanopyxis palmeriana</i>	+	+
<i>Thalassionema nitzschioides</i>	+	+
<i>Hemiaulus Hauckii</i>	+	+
<i>Asterionella japonica</i>	+	+
<i>Biddulphia sinensis</i>	+	+
<i>Actinopterychus undulatus</i>	+	+
<i>Rhizosolenia alata forma indica</i>	+	+
<i>Rh. hebetata forma semispina</i>		+
<i>Chaetoceros compressus</i>	+	+
<i>Ch. furca</i>	+	+
<i>Ch. pacificus</i>	+	+
Dinoflagellates		
<i>Ceratium tripos</i>	+	+
<i>Cer. fusus</i>	+	+
<i>Cer. pennatum</i>		+
<i>Cer. macroceros</i>		+
<i>Cer. trichoceros</i>	+	+
<i>Peridinium oceanicum</i> var. <i>oblongum</i>	+	+
<i>Per. depressum</i>	+	+

Number of species: Among 48 important plankton species observed in this survey, 20 species were zooplankters, and the remaining 28 were pelagic

phytoplankters. The number of species at each station is shown in the following table. It was almost equal at each station.

Table 1. Number of species occurring at each station.

Station No.	Nagasaki Harbour												Nagasaki Bay									
	1	2	3	4	5	6	8	9	10	11	12	15	16	14	13	17	20	21	29	28		
Zooplankton	15	14	14	17	18	17	16	17	16	17	15	15	16	17	18	18	16	17	17	16		
Phytoplankton	26	23	20	25	25	23	22	25	27	26	24	23	23	21	22	24	27	26	25	23		
Total	41	37	34	42	43	40	38	42	43	43	39	38	39	38	40	42	43	43	42	39		
Mean	40												41									
Total species throughout the stations			44												48							

24	23	18	19	22	27	26	30	31	25	32	33	Total species
18	17	18	16	19	19	16	17	18	17	19	18	20
21	24	26	27	25	24	21	25	24	24	23	26	32
39	41	44	43	44	43	37	42	42	41	42	44	52

General Consideration on Regional Distribution

Based on the dominant species of the plankton community, Nagasaki Bay and Harbour may be divided into three areas (Fig. 8).

1. *Oithona nana* area.

The harbour and the northern half of the bay were densely occupied by *Oithona nana*. Its densest population was found at 2 stations namely St. 2 in the head of the harbour and St. 15 in the northern part of the bay. The stations of small population in the bay were found along the route of current. The distribution of *Oithona nana* is similar to that observed in Akkeshi Bay, Hakodate Harbour and Imari Bay. This association was represented chiefly by nauplii of *Oithona nana*, and small numbers of copepods, such as *Paracalanus parvus*, *Microsetella norvegica* and *Oithona similis*, were found together. Associated diatoms were *Chaetoceros* spp., *Thalassiothrix Frauenfeldii* and *Bacterias-trum hyalinum*. The animal productivity was very large, but vegetative pro-

ductivity was relatively small in this area. The hydrological features of this area are as follows; the water is of fairly low salinities, well stratified, yellowish brown in color and small in transparency. It was also characterized by high pH values and high supersaturation degree of oxygen content, excepting a narrow polluted area of the innermost part of the harbour.

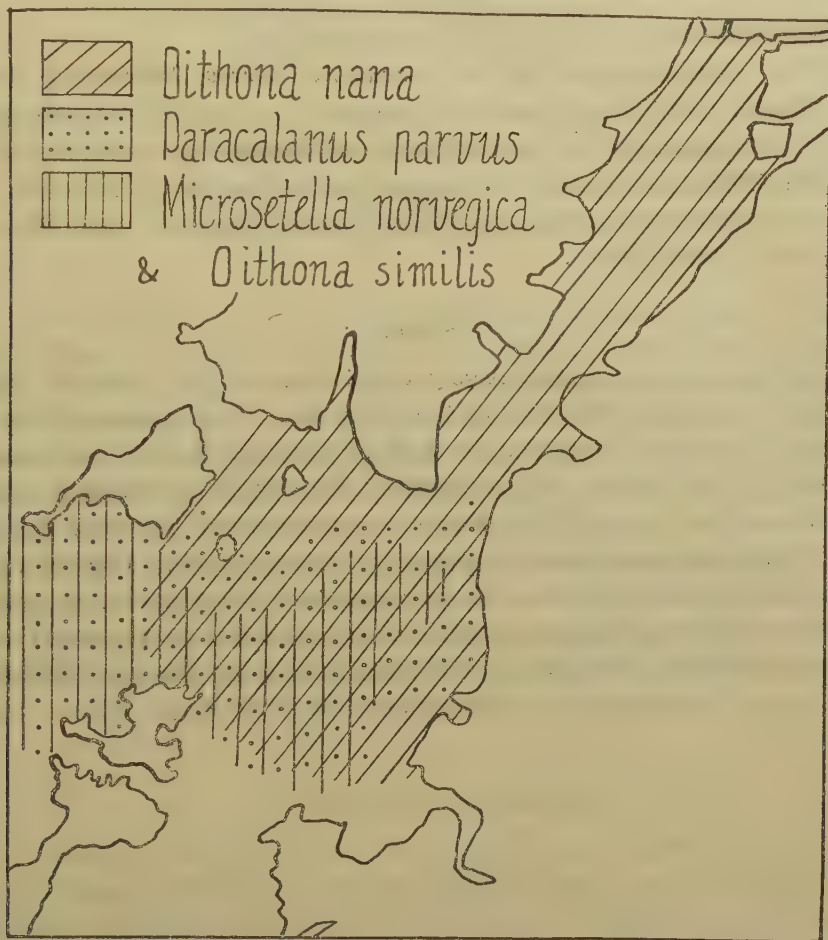


Fig. 8. Distribution of dominant copepods.

2. *Oithona nana*—*Paracalanus parvus* area.

Oithona nana community was also associated with *Paracalanus parvus*, *Microsetella norvegica*, *Corycaeus crassiusculus* and *Oithona similis* in the center of the bay. This area was dominated by a neritic copepod *Microsetella norvegica*, which was very scarcely found in Imari Bay. The number of species in this area was the same as the *Oithona nana* area, but the population density

of animals was relatively small. Owing to the abundance of *Chaetoceros*, the density of phytoplankton was larger than that of the above-mentioned area.

The water of this area was relatively stagnant and showed comparatively higher salinity, pH values and supersaturation degree of oxygen content than in the *Oithona nana* area, although it was diffused by polluted water flowing out from the harbour,

3. *Paracalanus parvus*—*Microsetella norvegica* area.

The neritic copepods, such as *Paracalanus parvus*, *Microsetella norvegica* and *Oithona similis* were found near the mouth of the bay, whence open sea water invades into the bay and harbour, and formed an intermingling area with the *Oithona nana* area in the central part of the bay. The water of this area was relatively stagnant and showed higher transparency and lower water color than in other areas.

Summary

In conclusion, the productivity of diatoms in the Nagasaki Bay and Harbour was greater than that of the Imari Bay. This is probably due to the continued supply of abundant nutrient matter from the city of Nagasaki at the head of the harbour. The widespread distribution of *Oithona nana* extends to the mouth of Nagasaki Bay where the oceanic influx is rather strong.

The larger population of the strictly inshore copepod, *Oithona nana* and poorer population of smaller offshore copepods in the plankton composition is correlated with an advanced degree of bay characters as contrasted with the oceanic characters. This fact may be taken as a proof that the Nagasaki Bay is of stronger embayment characters than the Imari Bay.

PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

V. THE PLANKTON OF HIROSIMA BAY IN THE SETO-NAIKAI (INLAND SEA)*

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With 7 Text-figures

Hirosima Bay, which is remembered as a base of the former Japanese Navy, is also famous for its oyster farming, but no detailed oceanographical survey has ever been made. The present paper deals with the results of a preliminary survey made on October 12, 1951, and forms a part of my planktological investigations of Japanese inlet waters. Owing to the lack of time, however, the field work was confined to the northwest small area of the bay lying just southwest of the city of Hirosima.

For general oceanographical conditions of the southern part of this bay, the reader is referred to the reports published by the Kōbe Marine Observatory (SUDA et al 1930; OKADA et al 1936) and Fisheries Experimental Stations (UDA & WATANABE, 1933). For methods of investigation refer to my preceding papers of this series.

Hydrological Conditions

Hirosima Bay represents one of the most significant bays in the Seto-naikai or Inland Sea, forming a large indentation of about 50 km long in the N-S direction and 40 km wide in the E-W direction. Its coast line is curved evenly with slight arms or inlets, but is studded with many islets of various sizes. The tidal range of the bay is great, more than 3 meters in extent, and the current is very strong during inflow or outflow, especially between islets.

* Contributions from the Seto Marine Biological Laboratory, No. 189.

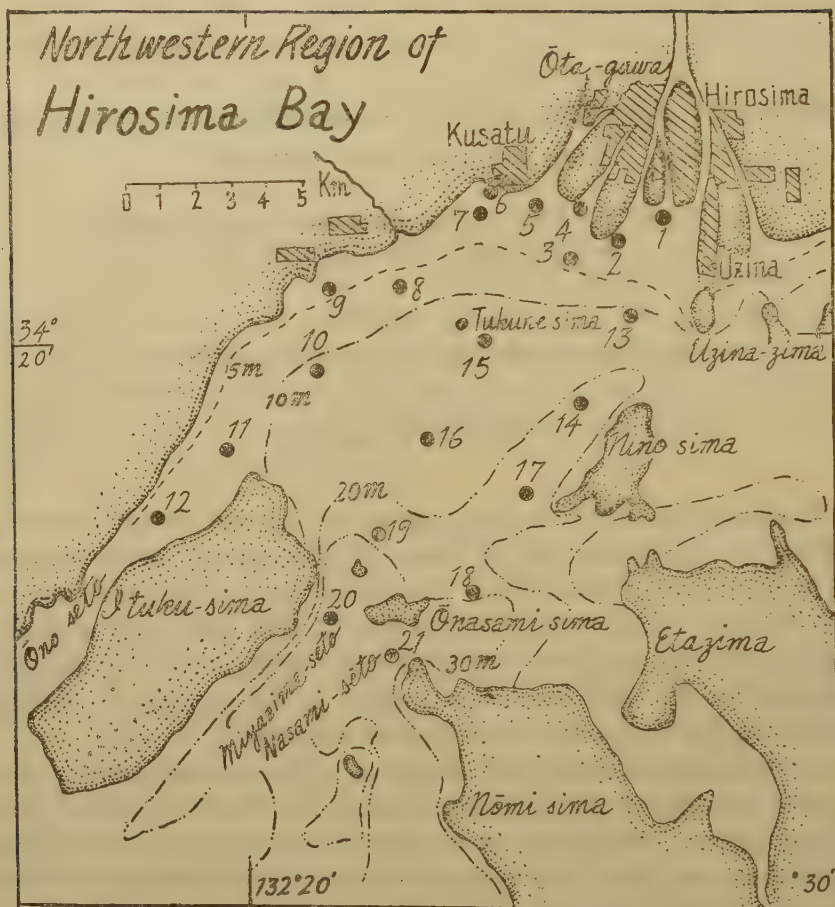
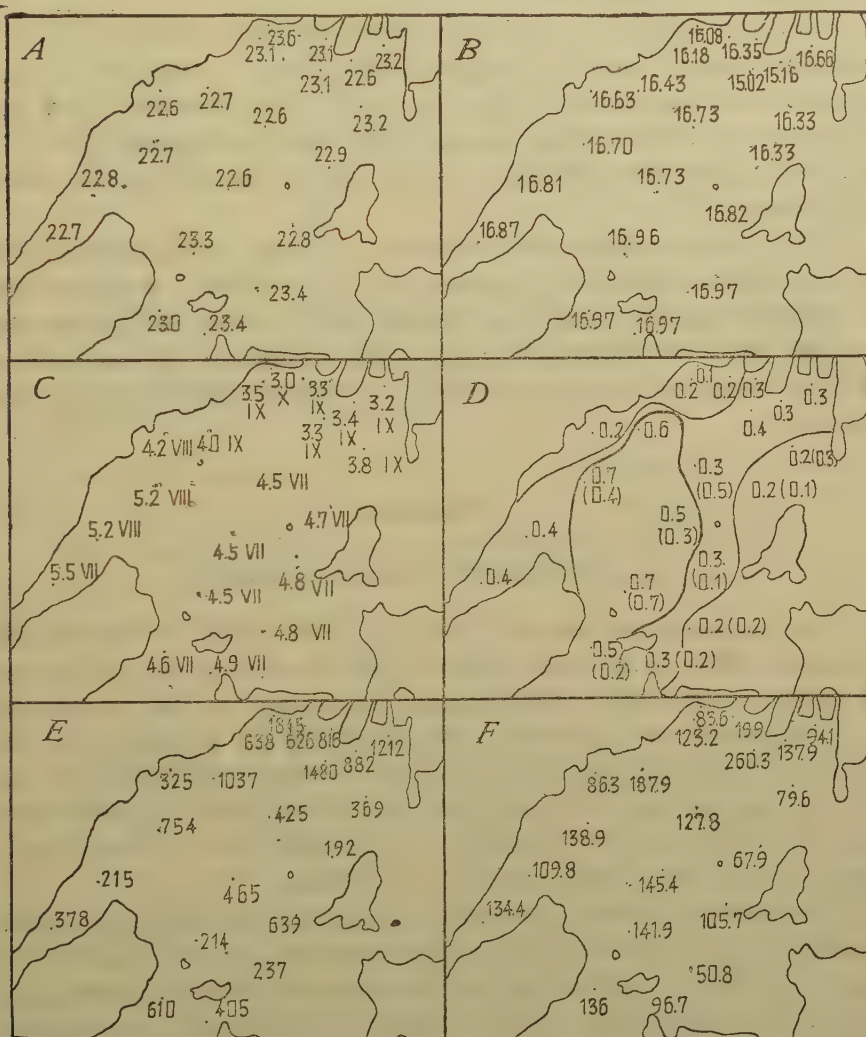


Fig. 1. Map of the northwestern region of Hiroshima Bay showing stations and isobaths.

The surveyed area (Fig. 1), which is the northwest part of the head of the bay, is surrounded by the southern coast of Tyūgoku Region on the north and west, and connects the main region of the bay with a wide channel of about 3.5 km between two large islands Ituku-sima and Nōmi-sima on the south, and communicates on the east with Uzina-wan, which is the northeast part of the head of the bay.

Main part of the surveyed area is relatively shallow, ranging from 9 m to 13 m. Only southwards the 20 m isobath line runs from the northern end of Ituku-sima to the northern end of Nino-sima. The greatest depth is found at the central part of two channels of the southern entrance (Miyazima-seto and Nasami-seto), measuring about 58 m and 54 m respectively.

Hirosima Bay receives many rivers especially at its head and on the west coast, and a large delta or alluvial bank is formed near the mouth of Ōta-gawa, which passes through the city of Hirosima. This is only an influent which empties into the surveyed area. The shallow basin near its estuary is



largely occupied by the oyster farm with spat-collecting bamboos in wide areas, they are set so thickly that it is difficult for a boat to pass.

Although the bay is thus well protected from the open sea, the water circulation seems to be rather good by strong tidal current. But the influences of rivers are conspicuous.

So far as my field work concerns, the surface temperature of the surveyed area ranged from 22.6°C to 23.4°C, being lower in the central area than in the northern and southern areas (Fig. 2, A). The chlorinity of the surface water was generally uniform and relatively small, being from 15 to 17 Cl ‰ (Fig. 2, B). Such low chlorinity is largely due to the dilution by spread of river waters.

The water was more yellowish brown and less transparent in the innermost part near the mouth of Ōta-gawa (nos. 9-10 of FOREL's scale and 3-4 m of the SECCHI's disc) than near the western (nos. 7-8 and 4-5.2 m) and southern entrances (no. 7 and 4.5-5 m); the most turbid water (no. 10) was found at St. 6 at the mouth of Ōta-gawa (Fig. 2, C). Other items were not observed whatever.

Plankton

A. Quantitative Analysis of Plankton

The plankton samples were collected at 21 stations. The settling volume of plankton (Fig. 2, D) was larger in the central part than in the eastern and western parts. The smallest volume was found near the northern coast.

The plankton was relatively rich throughout all stations. The largest number of individuals, cells or colonies per 10 liters was 290 thousands at St. 3 and the smallest was 50 thousands at St. 18. More than 200 thousands were counted at 3 stations, 190 thousands at one station, 100-150 thousands at 10 stations and less than 100 thousands at 7 stations.

The relation between the settling volume and the population density is generally parallel to each other in the eastern part, but irregular in the western and central parts, where the plankton was relatively small in density (Fig. 3). This may be due to the richness of small-sized diatoms such as *Skeletonema costatum*.

The largest number of zooplankton was found at St. 1-4 near the northern coast, where it attained 700-1800 per 10 liters. The smallest was in the eastern half, measuring only 400 per 10 liters as shown in Fig. 2, E. The population of phytoplankton was also very large throughout all stations. It was found densest at St. 3 near the northern coast, whence the number ob-

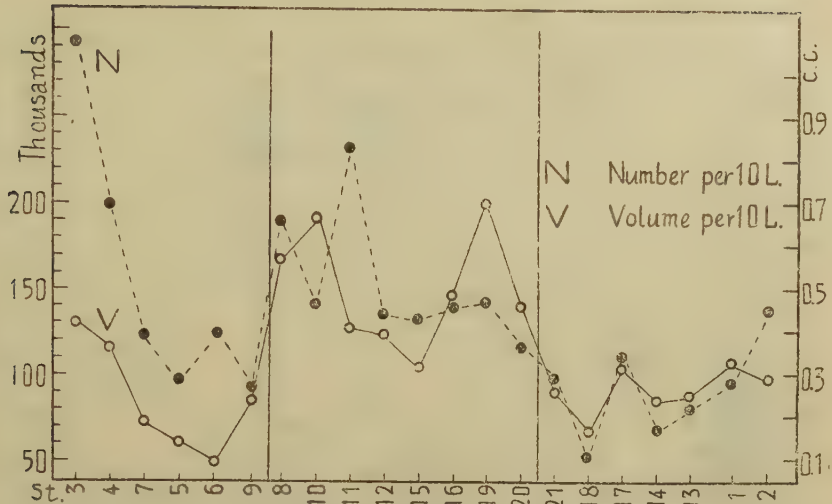


Fig. 3. Relation between the settling volume (cc) of plankton and the number of individuals, cells or colonies (each per 10 liters).

tained was 260 thousands per 10 liters. The smallest was found at St. 18, 13 and 14 in the eastern part, measuring only 50–80 thousands (Fig. 2, F).

The numerical percentage of phytoplankton in the total plankton ($P/N \times 100$) was very large, more than 99 %, with a single exception of St. 6 (off Kusatu port) where it was less than 97.8 %.

B. Qualitative Analysis of Plankton

Zooplankton: The important component of zooplankton (Fig. 4) was copepods (20–70 %). Next came the other animals, such as Protozoa, medusae, Copelata, Chaetognatha, Cladocera, etc., all of which were represented by about 5–35 % in totals. Larval forms of animals, such as polychaetes, molluscs, copepods and cirripeds, were represented by 20–50 % in the total zooplankton. As shown in Fig. 4, these composition varied from station to station. Among copepods the following 11 species were discriminated at each station: *Paracalanus parvus* (20–73 %), *Oithona nana* (5–50 %), *Oithona similis* (1–40 %), *Acartia clausi* (0–45 %), *Microsetella norvegica* (0–43 %), *Oncaea venusta* (0–15 %), *Eutерpe acutifrons*, (+) *Corycaeus crassiusculus* (0–1 %), and *Eucalanus attenuatus* (+) *Calanus pauper* (0–0.5 %). Of these, only the last-named two are offshore species, and the rest inshore forms. The surveyed area was predominated by *Paracalanus parvus* which was abundant in the inner region and smallest near Kusatu Port (St. 6) (Fig. 5). It increased gradually southwards. *Oithona nana*,

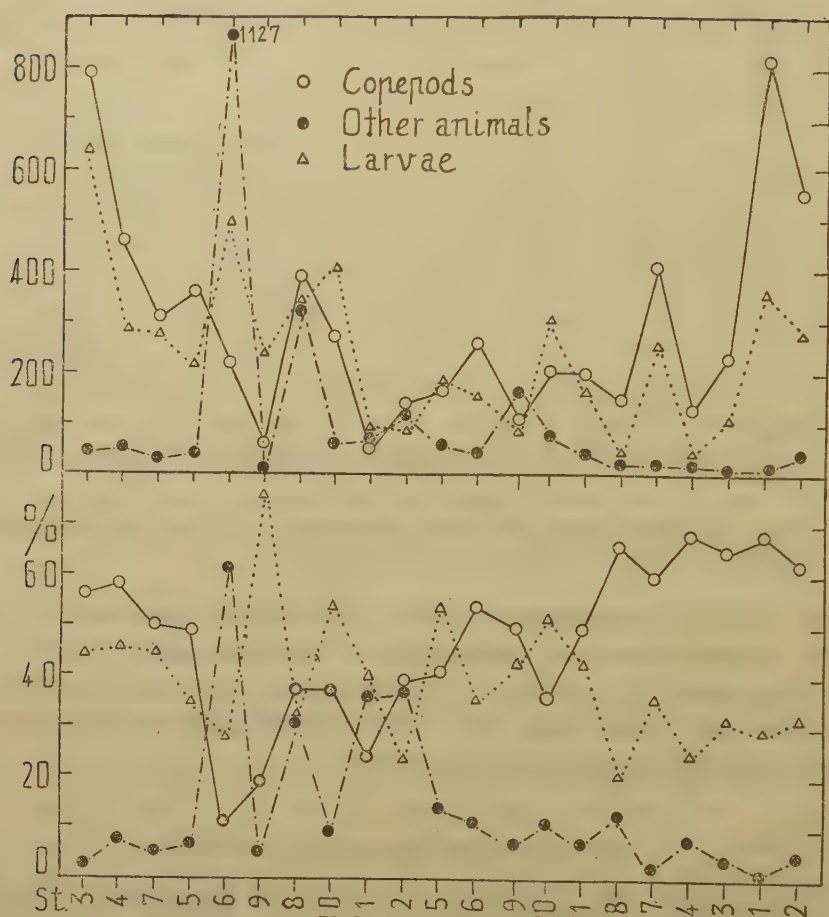


Fig. 4. Population density (above) and percentage composition (below) of zooplankton (each per 10 liters).

which was the next important species among zooplankters, was only found in abundance in the northern area and decreased towards the southern channel in contrast with the case of *Paracalanus parvus*. The population of *Acartia clausi* was restricted to the innermost area near Kusatu Port. *Oithona similis* was found rather abundantly in the offshore area towards the eastern and southern channels, but scantily in the inshore area. *Microsetella norvegica*, *Corycaeus crassiusculus* and *Oncaea venusta* were also found in the eastern half of the central area. Calanoids such as *Eucalanus attenuatus* and *Calanus pauper* occurred scarcely in the offshore area.

Sagitta crassa f. *naikaiensis* (Chaetognatha) and *Oikopleura dioica* (Cope-lata) which are considered as typical indicators of inland water (TOKIOKA,

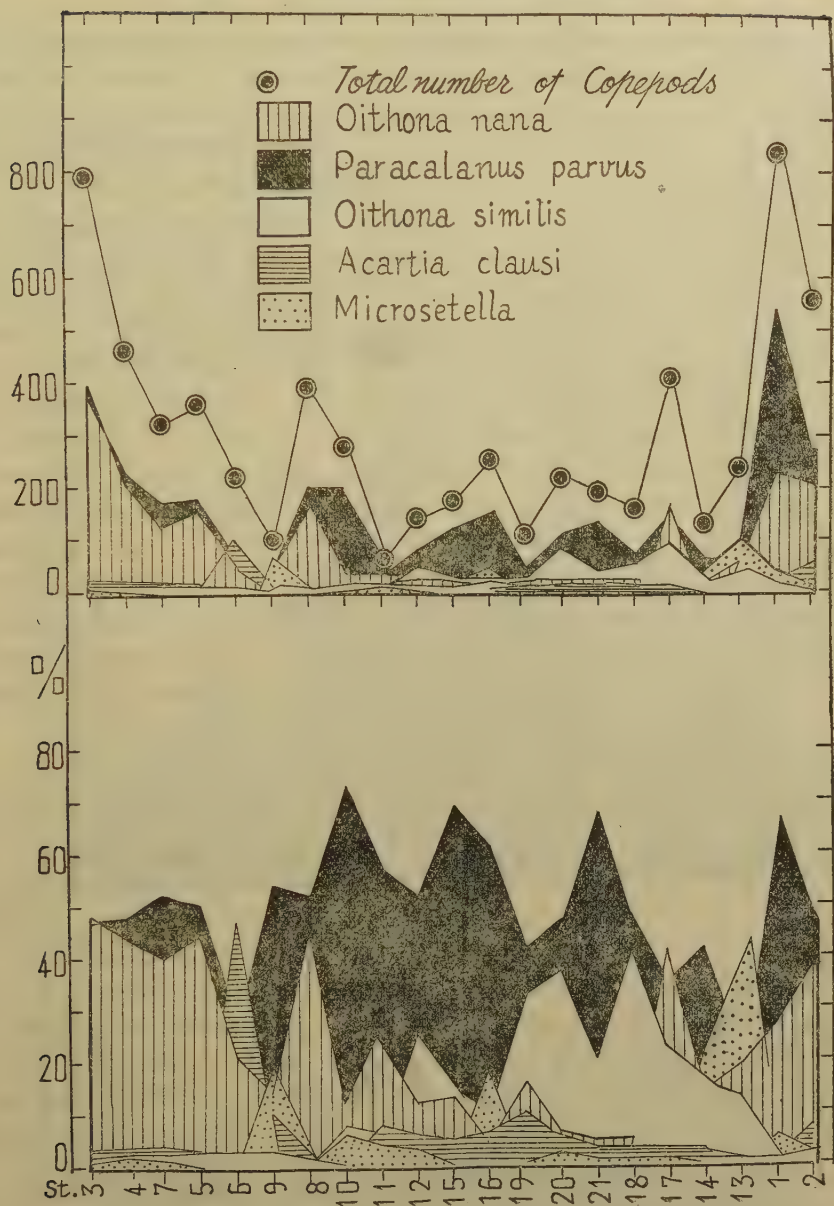


Fig. 5. Individual number (above) and percentage composition (below) of important copepods caught per one meter haul (10 liters of water) between surface and 5m depth.

1939), and *Evadne nordmanni* and *Penilia schmackeri* (Cladocera) were widely distributed. Among protozoans, *Favella campanula*, *Tintinnopsis radix*, *Tin. cylindrica*, *Tin. nordquisti* etc., were found sparsely in the inner region and *Favella campanula* only was abundantly in the innermost area near Kusatu Port. At

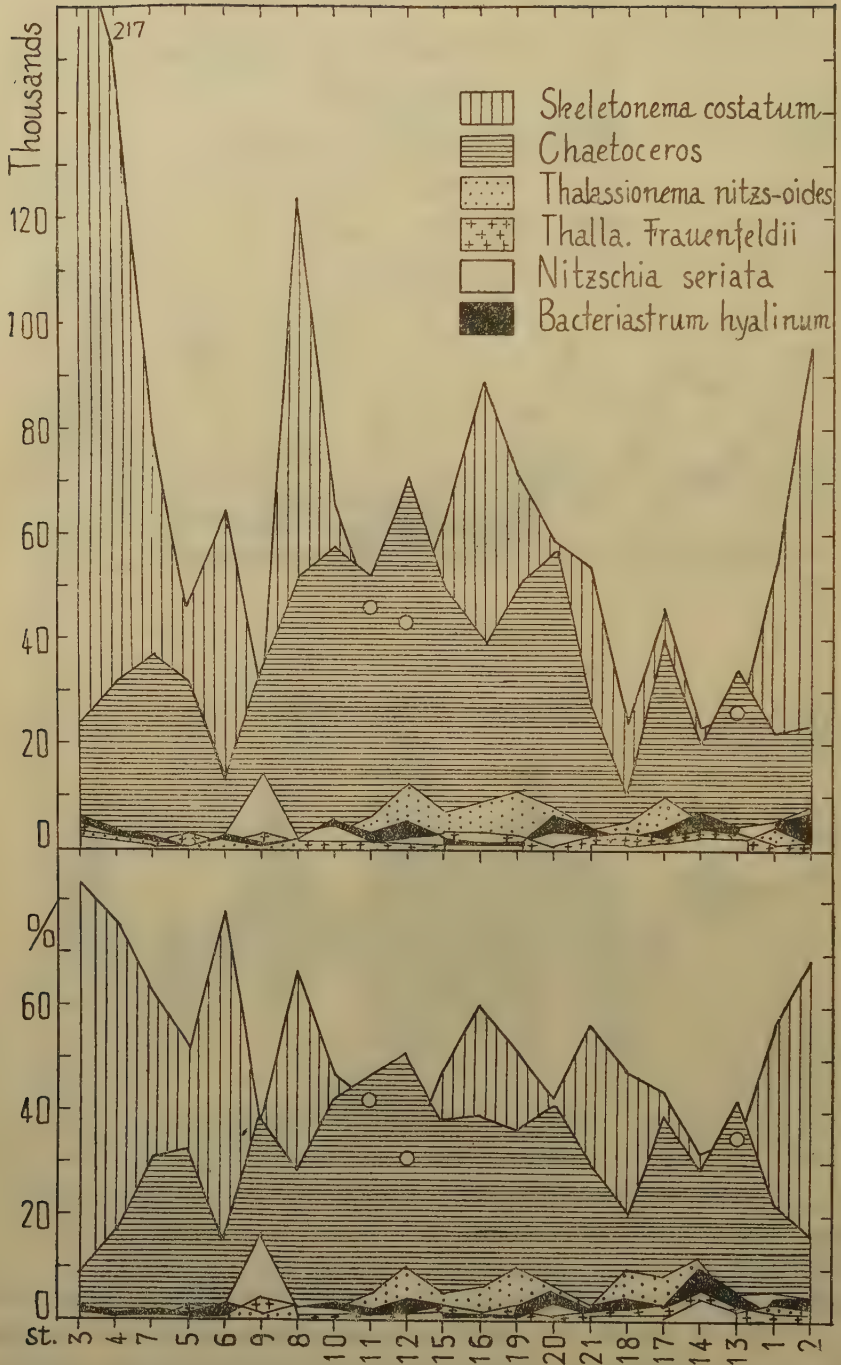


Fig. 6. Cell or colony number (above) and percentage compositions (below) of important diatom groups.

the center of the surveyed area there were found some offshore forms, such as *Muggiaea atlantica*, *Sticolonche zanclea* and *Sagitta enflata*. The larval forms were mainly represented by nauplii of copepods in the inshore region. The cirripedian nauplii and molluscan veligers were also frequent.

Phytoplankton: Diatoms showed almost the same composition at all stations, although varying in frequency of occurrence (Fig. 6). *Skeletonema costatum* and *Chaetoceros* spp. were dominant throughout the whole stations. *Skeletonema* occurred considerably in abundance along the northern coast and decreased southwards. On the other hand, *Chaetoceros* such as *Ch. coarctatus*, *Ch. peruvianus*, *Ch. denticulatus*, *Ch. tetrastichon*, *Ch. didymus*, *Ch. decipiens*, *Ch. Lorenzianus*, *Ch. laevis*, etc., were very abundant mainly in the central area towards the southern channel, and similarly decreased in the northern and eastern areas. *Thalassionema nitzschioides*, *Thalassiothrix frauenfeldii*, *Nitzschia seriata* and *Bacteriastrum hyalinum* were also frequent as important components.

The distribution of dinoflagellates (including 7 species) was rather uneven. Among them *Ceratium fusus* and *C. furca* were most frequent at St. 20 near the southern channel, and the smallest in the central area. *C. tripos*, however, rather evenly occurred in the whole area.

It is thus clear that a remarkable dissimilarity exists in the composition and distribution of plankton of Hirosima Bay and those of Imari and Nagasaki Bay where have hitherto been surveyed (YAMAZI, 1952 a, b).

Many offshore forms were found also in this bay. It seems that these immigrant species were brought into this area by the strong tidal currents and southerly winds. They are listed as follows:

Zooplankton; *Calanus pauper*, *Eucalanus attenuatus*, *Acanthometron pellucida*, *Sticholonche zanclea*, Radiolaria spp. *Muggiaea atlantica*, *Sagitta enflata*.

Phytoplankton; *Chaetoceros coarctatus*, *Ch. peruvianus*, *Ch. denticulatus*, *Ch. tetrastichon*, *Rhizosolenia setigera*, *Rh. imbricata*, *Rh. alata* forma *indica* and *Guinardia flaccida*.

General Consideration on Regional Distribution

The local difference in topographical and hydrological features in the inner region of Hirosima Bay are generally inconspicuous. But as the tidal current is relatively strong, the influence of the open sea water is appreciably recognized. The salinity of surface water shows a considerable decrease towards the mouth of Ōta-gawa, where the water is yellowish brown and

less transparent. The following three areas (Fig. 7) may be recognized according to the distribution of dominant zooplankters.

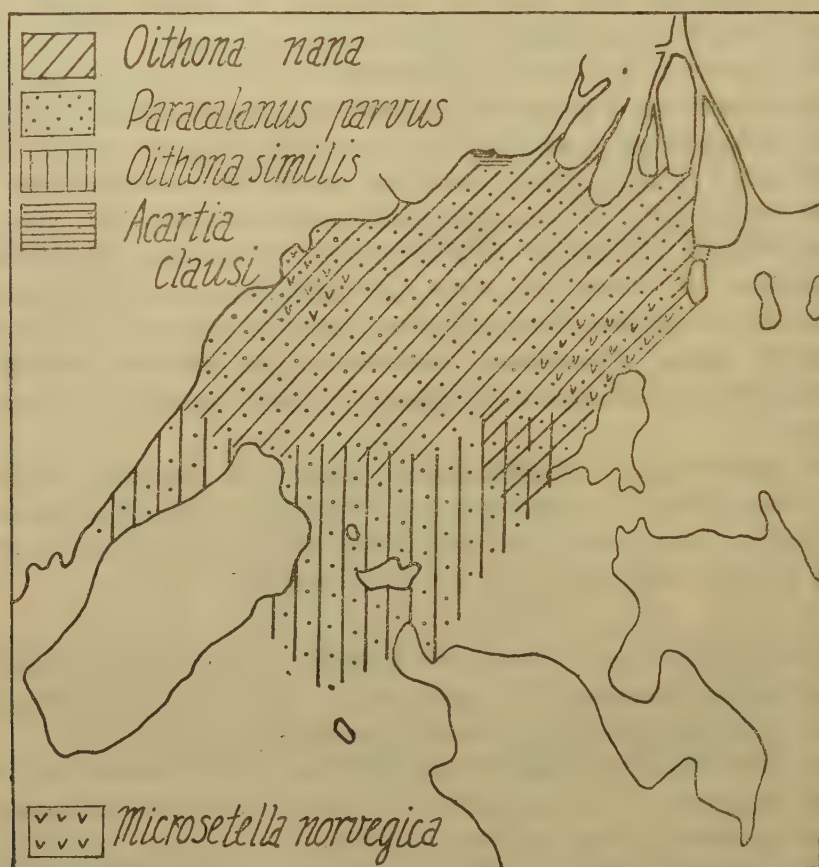


Fig. 7. Distribution of dominant copepods in the northwestern region of Hiroshima Bay.

1. *Acartia clausi* area.

This area, which is dominated by the strictly inshore species *Acartia clausi*, is restricted only to the pier of Kusatu. This species was widespread over the bay in small numbers. It was also very abundant in the innermost part of Ago Bay (TOKIOKA and YAMAZI, 1950; TOKIOKA, YAMAZI and HUSE, 1951). According to BIGELOW (1926 and BIGELOW and SEARS (1839), this copepod is restricted to the neritic region of the Gulf of Maine. GURNEY (1928-1929) reported it as a littoral and brackish form, and DEEVEY (1948) found it in the Tisbury Great Pond in abundance from winter to late spring, and said that it is "fairly euryhaline and eurythermal species surviving unfavor-

able conditions either as resting stages or in small numbers". The water, where it was abundant, showed yellowish color and low transparency, but the salinity was almost similar to that of the neighbouring area.

2. *Paracalanus parvus*—*Oithona nana* area.

In the inner region, *Paracalanus parvus* and *Oithona nana*, commonly occurring in most bay or inlets, were distributed densely. The percentage composition of the former species in the total plankton was greater in the northern region than that of the latter, while in the southern region it was the reverse. They were associated with a copepod, *Microsetella norvegica*, diatoms (*Skeletonema costatum* and *Chaetoceros* spp.) and several species of dinoflagellates.

3. *Paracalanus parvus*—*Oithona similis* area.

In the southern region, however, *Paracalanus parvus* and *Oithona similis* were predominant. The composition in this area was similar to that of the preceding area, but the population density was smaller. Such diatoms as *Chaetoceros* and *Thalassionema nitzschioides* were more abundant as associates.

In contrast with the cases of Imari Bay and Nagasaki Bay it is remarkable that the plankton community of Hiroshima Bay consists largely of the ecotone of *Paracalanus parvus*, associated with *Oithona nana* and *O. similis*, and lacks the *Oithona nana* sociation; that is, the *Oithona nana* area, as usual in Imari Bay and Nagasaki Bay, was weakly developed in this bay, at least in the surveyed area. In addition, offshore forms brought into by the tidal current and southerly winds were relatively abundant. This may probably be interpreted as due to influence of the open sea water inflowing through the course of Hōyo Strait—Iyō-nada, where is the widest area of the western part of the Inland Sea.

REFERENCES

- BIGELOW, H. B. 1926. Plankton of the offshore waters of the Gulf of Maine. Bull. U. S. Bur. Fish. (1926), 40 (2).
BIGELOW, H. B. & M. SEARS. 1939. Studies of the waters of the continental shelf, Cape Cod to Chesapeake Bay. III. Volumetric study of the zooplankton. Mem. Mus. Comp. Zool. Harv., 54 (4).
DEEVEY, G. B. 1948. The Zooplankton of Tisbury Great Pond. Bull. Bingham Oceanogr. Coll., 12 (1).
GURNEY, R. 1928-1929. The fresh-water Crustacea of Norfolk. Trans. Norfolk Norw. Nat. Soc., 12 (cited from DEEVEY, 1948).
OKADA, T. et al. 1936. Report of the oceanographical observations on board R. M. S. Syunpū Maru in western half of the Seto-Naikai (Inland Sea of Japan) in the winters, 1930, 1932 and 1933. Jour. Oceanogr., 9 (2), pp. 101-270, 182 pls. (In Japanese, with English résumé).

- SUDA, K. et al. 1930. The results of the oceanographical observations on board R. M. S. "Syunpū Maru" in the Seto-Naikai (the Inland Sea) in the year 1928, 1929, and 1930. Part I and II. Ibid., 2 (2), pp. 335-433, 109 pls; 2 (4), pp. 537-643, 170 pls.
- TOKIOKA, T. 1939. Three new chaetognaths from Japanese waters. Mem. Imp. Mar. Obs. Kobe, 7 (1).
- TOKIOKA, T. 1939. Notes on chaetognaths and pelagic tunicates of Osaka Bay. Umi to Sora, 19 (6). (In Japanese).
- TOKIOKA, T. & I. YAMAZI. 1950. Studies on the pearl fishing ground of Ago Bay. I & II. Kyoto Daigaku, Seiri-Seitai Kenkyū Gyōseki, Nos. 70 & 71. (In Japanese).
- TOKIOKA, T. YAMAZI, I. & S. HUSE. 1951. Idem. V. Ibid., No. 73. (In Japanese).
- UDA, M. & N. WATANABE. 1933. Hydrographical researches on the normal monthly conditions of the Seto-Naikai. Jour. Imp. Fish. Exp. Stat., No. 3, pp. 137-164. (In Japanese with English résumé).

STUDIES ON THE FORMATION OF PEARLS. I.
ON THE RELATIONSHIPS OF PROTEINS AND CaCO_3
CRYSTALS IN THE LAYER OF BAROQUE PEARLS*

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With Plate XIII and 3 Text-figures

INTRODUCTION

On the formation of pearl layers, as well as on the mechanism of Ca deposition in the shells, there are still remain many problems unsolved.

We studied the abnormal structures which are often found in the culture pearls, in attempting to solve these problems.

As to material, we used the pearl named the "steel colored pearl" which is the most usual abnormal type, like a pear extruded on one side.

Our attitude was kept in these experiments and observations was limited in the following manner only the physico-chemical considerations were permitted as basis of scientific conclusion, while hypothetical and biological assumptions were excluded.

To know the abnormalities is the base for knowledge of the normalities. Since pearls are produced in living organism, they are not only consisted of large amount of Calcium Carbonate crystals, but also contain some amounts of organic substances commonly named "conchiolin," a kind of protein. The conchiolin was first reported by FREMY (1), and then studied by SCHLOSSBERGER (2), VOIT (3) WETZEL (4) and FRIZA (5). It was considered a kind of albuminoid, but there still remained many problems unsolved.

* Report of the Nippon Institute for Scientific Research on Pearls, No. 20.

Recently, our co-worker Dr. TANAKA and others have determined its albuminoid nature (6).

The differences of structure, distribution and properties of conchiolin layers must have an important influence upon the formation of CaCO_3 crystals.

In this study, we endeavoured to discover the properties of the proteins in the abnormal layers.

EXPERIMENTS AND RESULTS

Experiment 1. Protein content in appearance.

The protein contents were determined from the decalcified residues but not from the burning residues. Protein content in volume was calculated from specific gravities (7). The results obtained are shown in Table 1.

Although these results are a rough estimate, the protein contents were higher than those secured by burning methods (14). Therefore, a considerable amount of protein will be observed in the layer.

Table 1. The residues of organic substances decalcified using 3% HCL solution.
(sp. gr. 2.9 (I))

	Gr. used pearl piece	Gr. of dry residues after decalcified	Ratios in org. subst. per total gr.	Calculated volume of protein
1	0.3700	0.0521	14.0%	33.6%
2	0.5420	0.0773	14.2%	34.0%
Mean			14.1%	33.8%

Two supplemental experiments were made for direct observation of proteins.

a. Microscopical studies of decalcified conchiolin residues with paraffin sectionings and double stainings.

The method was the same as used generally in biological studies; the samples were sectioned by 20μ , and then stained with eosin and aniline blue.

They were stained out in layer structures, and the staining properties of the conchiolin were found to differ in the abnormal parts.

b. Decalcifyings and stainings under the polarization microscope.

The samples were ground into 20μ slices which are generally used in mineralogical observations. Stainings and decalcifyings were the same as

the experiment a. The sharp bi-refringence differentiated the CaCO_3 crystals from conchiolins.

Normal pearl layers were found as a concentrically built up films and as faintly double-stained layer.

The abnormal part in the pearl layer contained various structures of conchiolin such as a mass, grains, fibers, cylinders and thick colored layers. They were classified in two parts, namely acidophilic heavy stained portions and unstainable colored portions. The former had thick CaCO_3 crystal layers but the latter contained on the contrary no crystals. Thus, it seems that conchiolins may be well described merely in terms of protein in the following sections.

Experiment 2. The interrelation of CaCO_3 crystals and abnormal protein layers.

Samples were ground into 20μ , and sectioned with the plane containing the center of the nucleus and the top of the extruded abnormal part.

The polarization microscope was also used as well as in the previous observation. Proteins had no bi refringence, while the crystals showed a sharp bi-refringence. The abnormal structures are shown in Fig. 1. In the Fig. 1, (1) is the normal pearl layer and (2-11) are the abnormal layers. Moreover the latter was divided into the large crystal layers (2-5) and no crystal layers (8-9). (2-4) are the thick crystal layers which contain a radial protein structure, (5) is a random crystal layer, and (6-7) are independent giant crystals.

The proteins in these abnormal structures were also stained eosinophilic as reported above.

No crystal layers (8-10) consisted of colored organic substances of yellow, brown and black.

These substances were unstainable. (ref. Photo. (1) (3) and (7))



Fig. 1. Section of pearl layer, showing the abnormal structure. For further explanation see text.

Experiment 3. The bulk and the axiality of the crystals in the abnormal layers.

The axiality of each crystal was determined by the interference bands. Contrary to our expectations in all the cases it was found to be diaxial (ref. Table 2).

Table 2. Axiality of the abnormal crystals.

Structures	No.	in Fig. 1	Axiality
Normal pearl layer.		1	di-axial
Abnormal pearl layer	A	2	"
"	B	3	"
"	C	4	"
"	D	6	"

The bulk of the crystals showed us evidences of development velocity of crystals.

The results were obtained by the following three methods.

a) The thickness of the continuous layers tangentially to the nuclear surface was measured.

It was easily imaginable that these should have developed simultaneously. They showed distinctive thickness in the abnormal part (Fig. 1).

b) The bulk of the crystals can be observed with bi-refringence by rotated nicols. Oriented or random arrangement of crystals are differentiated by this method.

In Fig. 1, the crystals in 1, 2, 3 and 4 are arranged in certain directions, while 5, 6 and 7 contain a randomly arranged crystal or an independent large crystal. 1 and 5 are fine crystals and others are large crystals.

But this method was not always useful as to details.

c) The zone containing all structure was decalcified simultaneously.

This method was used for a principle by which the dissolving velocity of the CaCO_3 crystal in 3% HCl solution is inversely proportional to its bulk surface. The selected zones must contain all the layers which were classified in experiment (1). Several seconds after the HCl solution had been added, samples were washed with water quickly and the procedure was stopped. The magnitude of the residual crystal will suggest crystalization velocity.

By this method, it was confirmed in general that the abnormal layers containing eosinophilic proteins might be reconciled with rapid crystalizability. (ref. Photo. 2, 4 and 5)

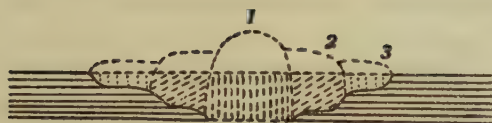


Fig 2. Method of decalcification by HCl solution

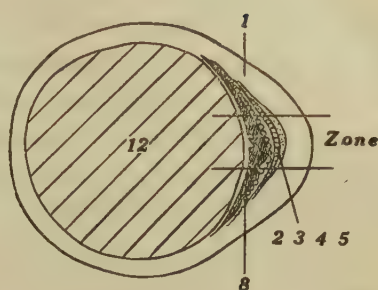


Fig. 3. Total section of baroque pearl

Experiment 4. Structures of the normal pearl layer.

It is difficult to prepare the samples under 20μ thickness. In order to prepare the $1-0.5\mu$ sample which correspond to the height of unit pearl layer (7) (8), the selected normal pearl layer in the 20μ sample was decalcified by a method shown in Fig. 2. At first, a drop of 3% HCL solution is mounted at a position 1, and a few seconds later the mounted HCl solution is spread concentrically to the region 2 and so forth.

At the part 1 in Fig. 2, the separated protein layers were clearly shown (ref. Photo. 6). At the part 2, the separated CaCO_3 crystal layers were observed (see Photo. 5 and 6). But they were not always equal as to their thickness.

The mean values of several layers showed us that the thickness of unit layer was about $450-500\text{ m}\mu$, so that the crystalline layers were estimated to be of a thickness of about $200-300\text{ m}\mu$.

CONCLUSION

(1) The protein content from the decalcifying residue was higher than that resulting the burning method. It was estimated roughly to be about 14% in weight and about 30% in volume.

(2) At the central region of the abnormal part, the layers containing the organic substances were differentiated in order from the nuclear surface as such a layer of colored organic substances (8-10), layers containing eosinophilic protein structures arranged radially against the nuclear surface (2, 3, 4 and 5) and the layers stained faintly with both dyes.

(3) No crystals were found in the first layer, thick crystal layers in the second and oriented thin crystal layers in the last indicated by bi-refringence.

(4) The eosinophilic layers consisted mainly of thick oriented crystal layers.

Sometimes we observed random crystal layers and giant crystals. The higher rate of crystalizability in these layers was suggested by three methods.

(5) It was shown that the crystals must be of the aragonite form by observation of their interference bands.

(6) It was confirmed by the stepwise decalcifying method that the normal pearl layers consist of alternative layers of proteins and crystals, which are estimated at about 200–300 $m\mu$.

DISCUSSION

In appearance, there are found a considerable amount of organic substance in the pearl layer. The organic substances have been found about 30 % in volume by calculating from the specific gravity of protein, CaCO_3 and the pearl (8,8'). The Ca crystal protein ratio in weight was 17/3 and that in volume 7/3. Concerning studies of the baroque pearls almost nobody reported.

But it is interesting and important to study the mechanism of formation of the pearl layer. The innermost layer consisted of the colored organic substance, the abnormal center was unstainable and moreover no crystals were found there although these layers were very thick and complex.

The structural protein in the next abnormal layers was stained by acidic dyes such as eosine. The polymorphic structural protein in this layer may be considered as a basic substance.

Surprisingly, we found a large member of crystals produced in this layer.

Perhaps, the development velocity may be as rapid as a hundred times more than that of the normal layers. May these proteins and CaCO_3 crystals be in basic correspondence?

It is supposed that the normal pearl layer contains a neutral protein, because it was stained faintly with both acidic and basic dyes.

The alternative thin layers of proteins and crystals in the normal part suggest to us a low development velocity of the crystals. K. TAKAMOTO (9) had pointed out in his study of the wounded tissue that acidosis occurred in the first stage, followed an alkalosis, and then the wound was healed.

In the case of some molluscs, K. INAHARA (10) suggested that the secreted substances from the mantle cut into small pieces were stained first by Sudan III, eosine in the next phase and then in the last phase stained faintly by Malachite green. It can be imagined from these facts that the operation of inserting the nucleus may probably raise an abnormalities in an analogous process.

While the Calcite crystalizes in ordinary temperature, the aragonite appears at higher temperatures. It is conceivable that the other factors (except

the proteins) can have no influence upon the crystalization of the CaCO_3 in aragonite form in this case.

The mechanism of the rapid crystalization in the basic protein layers has to be studied further in more details.

It should be remarked that the normal pearl layer may be produced slowly in the normal biological condition. The alternative deposition of protein and CaCO_3 about 200–300 $m\mu$, though it is a rough estimation, shall be supported by the facts reported by I. HONJO (11), in which the shell was closed by light radiation and by S. MORI (12) in which activity was increased in twilight.

Here, the Ca protein ratio in the pearl layer was 17/3 in weight in this study. That of secreted mucoproteins was reported about 2/3 or 1/2 (13). The ratio in the muscle of some molluscs was less. (14).

The calcium detection in the mantle tissue by OJIMA (15) has shown that the Ca-oxalate crystals are found only in the peripheral portion.

MATSUI had always insisted that the oceanographic conditions, the Ca content of the sea water, would be important on calcification of shells.

The Ca content of the sea water is almost equal to the maximum solubility of the CaCO_3 . If CO_2 were produced by respiration or other factor in epithelial tissues, the CaCO_3 precipitation would be enabled to take place immediately.

Although it is not clearly decided, the protein secretion and Ca deposition might be to interrelated with each other. In these respects the mechanism in detail should be analysed further.

We wish to express our gratitude for Dr. HAYASE who has offered us many kind suggestions and conveniences, and also to the members of Seto Marine Biological Station of Kyoto University.

SUMMARY

1. Correlations between protein and CaCO_3 crystals in the baroque pearl layer were studied with the polarization microscope and double staining.

2. The protein content was determined from the decalcifying residue. The result showed us a higher protein contents than that of a burning method. In appearance, the protein contents were estimated at about 30 % in volume.

3. There were observed three sorts of protein layer; the colored unstainable organic layer, the basic protein layer and the pearl layer in the abnormal pearl.

4. The first layer could not be stained at all, the second stained with

acidic dyes and the third stained faintly by both acidic and basic dyes. Morphologically they were characterized as eddied, radial and thinly concentric.

5. No crystals developed at first. An extremely thick crystalization occurred in the second, and in the third, the proteins and the CaCO_3 crystals were found as alternative layers.

In the conoscopic observation, the interference band of each crystal had indicated diaxial form of aragonite.

The cause of abnormality in the baroque pearl depends upon both the basic and the unstained layers. It was supposed that these layers were probably occurred by the operation in which the nuclei were inserted.

LITERATURE

- (1) FREMY, E. 1855. *Ann. de Chem. et Phys.*, ser. 4, **1**, 43, 96.
- (2) SCHLOSSBERGER, J. 1859. *Ann. de Chem. et Pharmacie*, **13**, 99.
- (3) VOIT, C. 1860. *Z. f. Wiss. Zool.* **10**, 470.
- (4) WETZEL, G. 1899. *Z. f. Wiss. Physiol. Chem.* **13**, 113.
- (5) FRIZA, F. 1932. *Biochem. Zeit.*, **249**, 29.
- (6) TANAKA, S., HATANO, H. and others. *J. chem. Soc. Japan.* (Under print).
- (7) UCHIDA, Y. and UEDA, S. 1949. *Seiri-Seitai*, **1**, 3, 171.
- (8) OMORI, K. 1948. *Geographical Magazine*, **54**, 631.
- (8') ——— 1947. *Kagaku Asahi*, **7**, 34.
- (9) TAKAMOTO, K. 1950. *Seiri-Seitai*, **4**, 1—2, 59.
- (10) INAHARA, K. Unpublished.
- (11) HONJO, I. 1948. *Seiri-Seitai*, **2**, 2, 57.
- (12) MORI, S. 1948. *Jap. J. Malac.* **15**, 1—4, 46.
- (13) TANAKA, S. and HATANO, H. Unpublished.
- (14) OGUSHI, J. 1938. *Studies of Pearls.*
- (15) OJIMA, Y. 1952. *Cytologia*, **17**, 1.

EXPLANATION OF PLATE XIII

Fig. 1. The sample ground to 20μ Experiment 1.

A. Normal pearl layer. B—D. Abnormal layers. G. Nucleus. with ordinary microscope.

Fig. 2. Enlarged photograph of the abnormal region circulated in Fig. 1.

B. Irregular mass. C. Fiber. D. Cylinder. E. and F. Colored organic substances.

Fig. 3. Some abnormal structures of eosinophilic protein layers.

Fig. 4. Eosinophilic protein layers observed with the polarization microscope.

Fig. 5. Simultaneous decalcification of the zone contained every structure.

Fig. 6. Stepwise decalcification of the normal pearl layers. Upward arrow shows the separated protein layers and the downward the layer structure of the crystals in the normal pearl layers.

Fig. 7. Double staining. Upward half is not decalcified and downward half was decalcified. Heavily stained portion is the eosinophilic protein layers. A and E were not stained.



Y. MATSUI & T. HIROTA: STUDIES ON THE FORMATION OF PEARLS. (I)

STUDIES ON THE SEASONAL CHANGES IN THE CHEMICAL CONSTITUENTS OF THE PEARL OYSTER*

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With 8 Text-figures and 10 Tables

Not only in morphology but also in metabolism many marked differences have been observed between Invertebrata and Vertebrata. Especially differences in the chemical process of calcification are typical. The mechanism of shell formation by the mollusks, however, has not yet been so thoroughly studied as the process of bone formation.

Although a sort of pearls is produced by many kinds of bivalved mollusks, that of the pearl oyster, *Pinctada martensii*, is said to be superior. In the culture pearl industry of Japan, this kind of mollusk has been used almost exclusively (1) (2).

It may be expected that the quality of the pearl formed by the pearl oyster is influenced by various external conditions under which the pearl oysters have been cultivated. For several years the process of calcification in the pearl oyster has been studied from the biochemical standpoint at this laboratory (3). The seasonal variations in the chemical constituents of the pearl oyster were first investigated. Especially, since the inorganic constituents are presumed to have close relation to the formation of the pearl and of the shell, their seasonal changes were precisely investigated.

EXPERIMENTAL

Materials

The pearl oysters used in these studies were two- or three-winter mollusks cultivated at the beach of The Seto Marine Biological Laboratory of The Kyoto University at Shirahama Town in Wakayama Prefecture.

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Analysis were performed once a month from October to the following September. For the determination of glycogen content several oysters were treated at The Marine Laboratory and the rest were brought to The Biochemical Laboratory of The Kyoto University and a measurement of other constituents was conducted.

Methods

To determine the total weight, fresh meat and dried meat, water content, total nitrogen, lipids, glycogen and ash, fifteen oysters were used each time. The analysis of each constituent was carried out as follows (4).

Water (Moisture) and *ash*: Adductor muscles were separated from other parts and were dried at room temperature between filter papers. Water content was estimated from the decrease of weight after drying the meat at 105° to 110°C. in the oven. Dried meat was burnt to ashes in the muffle.

Total nitrogen (5): Total nitrogen was determined by KJELDAHL'S method using metallic selenium as completely oxidizing catalyst.

Lipids: Lipids were extracted with ether by using SOXHLET'S extractor for about sixteen hours from the dried meat, dehydrated in vacuum at 40°-45°C. for about six hours.

Glycogen (6): Since glycogen content in the pearl oyster is reported to be variable during the day (7), six oysters were taken up from the sea at 9 a.m. each time for the determination of glycogen content. As soon as possible glycogen was isolated from the fresh meats by means of PFLEGER'S method and was hydrolysed with HCl. The amounts of glucose thus formed were determined by FEHLING-LEHMANN-SHOORL'S method and the glycogen content was calculated.

Inorganic constituents (8): For the determination of the inorganic constituents, ashes from the dried meats of thirty oysters were used. The ash was treated with HCl and after filtrating the trace amount of silica separated, phosphate was precipitated by ammonium molybdate. From this filtrate iron and aluminium were precipitated by the addition of ammonia water. Calcium and magnesium were determined as oxalate and phosphate respectively with the filtrate from iron. With the solution free from phosphate, sulphate, magnesium, iron, aluminium and manganese by baryta, the determination of alkali metals was carried out by the platinum chloride method and also by the magnesium uranyl acetate method. Sulphate was measured as barium sulphate and chloride was also determined by the silver chloride method.

RESULTS AND DISCUSSION

Seasonal changes of the average values of total weight, of weight of the shell, of the fresh meat and of the dried meat, and content of water per oyster are shown in Table I and Fig. 1.

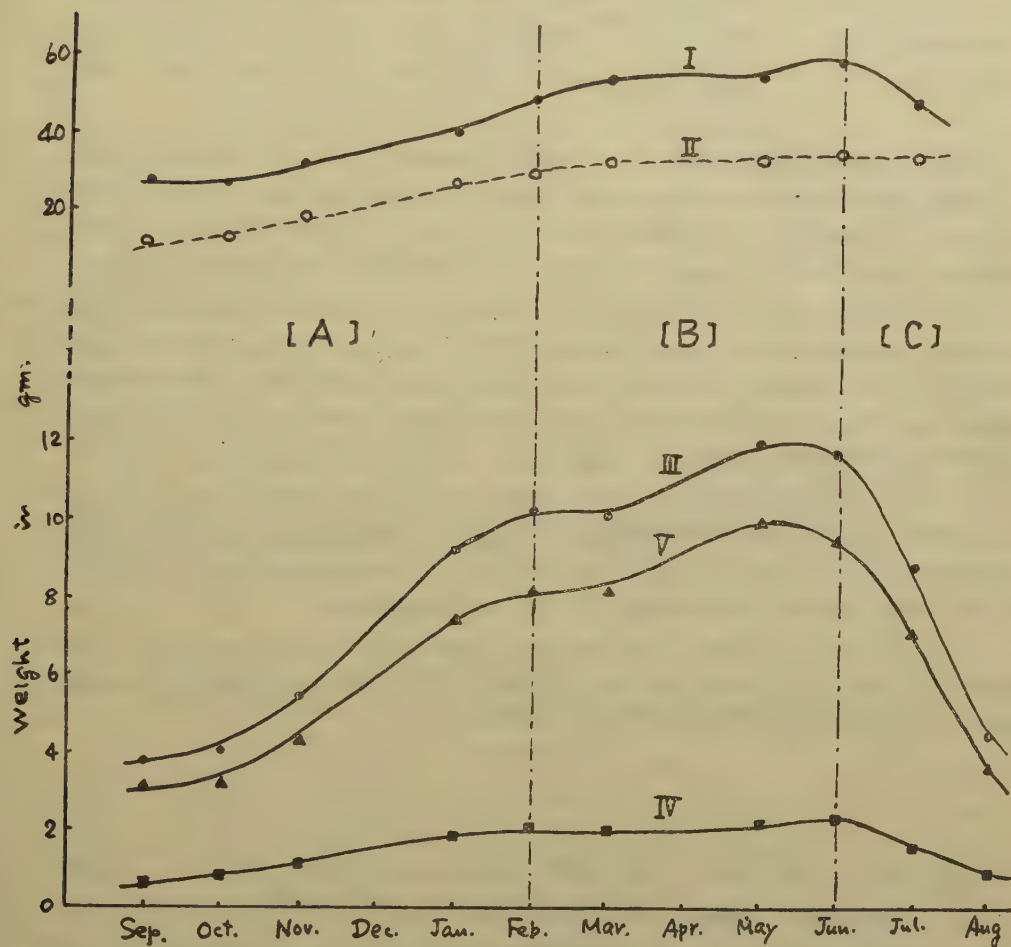


Fig. 1. The Monthly Changes in the Weight of the Pearl Oyster (per a Pearl Oyster). Curve I: Total weight, II: Shell weight, III: Fresh meat weight, IV: Dried meat weight and V: Water content. Period [A]: The fattening period, [B]: The ripening period and [C]: The reproductive period.

Table I.
The Monthly Changes in the Weight of the Pearl Oyster
(per a Pearl Oyster).

	Sep.	Oct.	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.
	g	g	g	g	g	g	g	g	g
Total weight	27.0	26.4	33.6	41.5	50.4	56.5	56.0	61.5	51.0
Shell weight	13.1	12.4	18.6	28.6	30.7	34.7	34.8	38.1	35.7
Fresh meat weight	3.83	3.98	54.8	9.31	10.28	10.10	12.11	11.36	8.84
Dried meat weight	0.64	0.77	1.14	1.78	2.05	2.00	2.17	2.32	1.60
Water content	3.18	3.22	4.34	7.53	8.23	8.10	9.95	9.55	7.24

Remarkable increases in total weight and weight of the shell throughout these experiments were observed. Fresh and dried meat increased gradually from September to the following June in weight. A sudden decrease to the extent of about half of weight in May was observed to occur in summer.

From these facts, the season from autumn to winter is presumed to be the fattening period of the pearl oyster, which in spring the vegetative growth ceases and the gonads gradually ripen (the ripening period). The summer is the reproductive period, when gonads have fully ripened and the discharge of the sexual products occurs.

It is noteworthy that in spite of decrease in the weight of the fresh meat, dried meat increases in weight during May and June. This fact shows that hydrolysis or other chemical reactions which need water may take place in the oyster before the discharge of the sexual products.

The monthly changes in the chemical constituents of the pearl oyster are shown in Table II-VII and Fig. 2-6. Those of the adductor muscle alone are shown in Table V and VII and Fig. 5 and 6.

Table II.

The Monthly Changes in the Chemical Constituents of the Pearl Oyster
(in Weight).

	Sep.	Oct.	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.	Aug.
	g	g	g	g	g	g	g	g	g	g
Total nitrogen	0.080	0.078	0.130	0.200	0.208	0.222	0.233	0.262	0.188	0.105
Crude protein	0.500	0.487	0.810	1.246	1.297	1.400	1.589	1.635	1.177	0.657
Lipids	0.059	0.084	0.102	0.191	0.241	0.110	0.094	0.113	0.058	0.073
Glycogen	0.003	0.033	0.079	0.150	0.176	0.264	0.150	0.163	0.110	0.011
Total ash	0.077	0.088	0.096	0.101	0.162	0.188	0.162	0.189	0.154	0.094

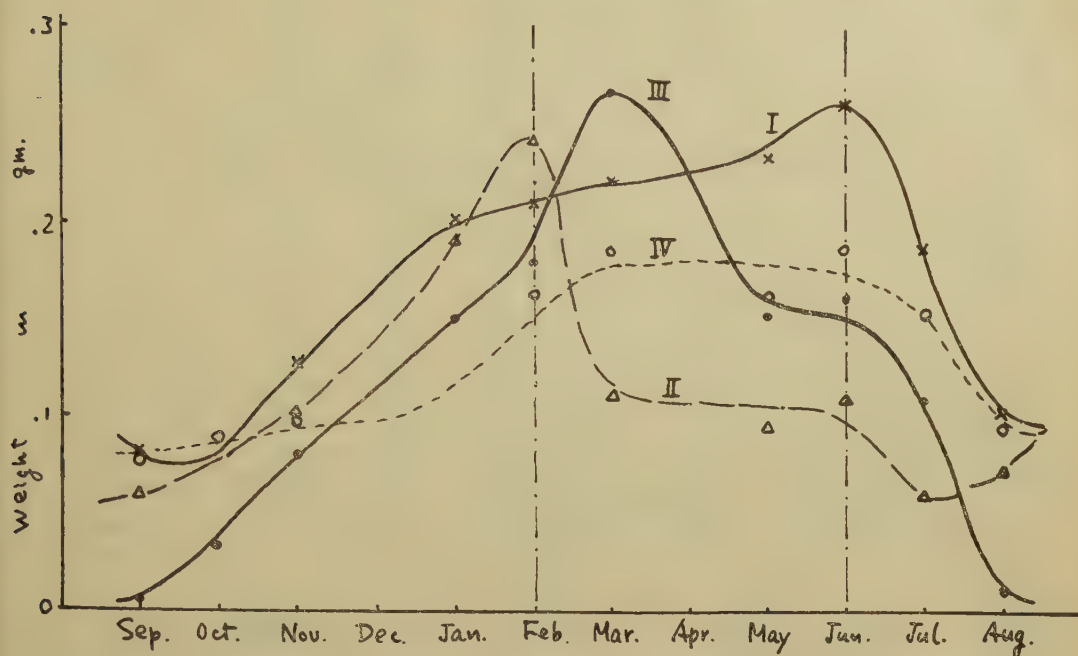


Fig. 2. The Monthly Changes in the Chemical Constituents of the Pearl Oyster (in Weight). Curve I: Total nitrogen, II: Lipids, III: Glycogen and IV: Total ash.

Table III.

The Monthly Changes in the Chemical Constituents of the Pearl Oyster
(in Percentage).

	Sep.	Oct.	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.	Aug.
	%	%	%	%	%	%	%	%	%	%
Water	83.24	80.56	79.40	81.20	79.85	78.11	81.50	80.22	81.57	80.54
Dried meat	16.76	19.44	20.60	18.80	20.15	21.89	18.50	19.78	18.43	19.46
Total nitrogen	12.50	10.13	11.39	11.21	10.13	11.10	11.72	12.28	11.76	12.23
Crude protein	78.20	63.31	71.16	70.06	63.30	70.00	73.24	70.50	73.52	76.45
Lipids	9.20	10.90	8.91	10.70	11.77	5.48	4.35	4.88	3.60	8.52
Glycogen	0.40	3.93	6.90	8.40	8.57	13.18	8.91	7.02	6.87	1.24
Total ash	12.10	11.41	8.40	5.65	7.90	9.41	7.46	8.13	9.63	10.85

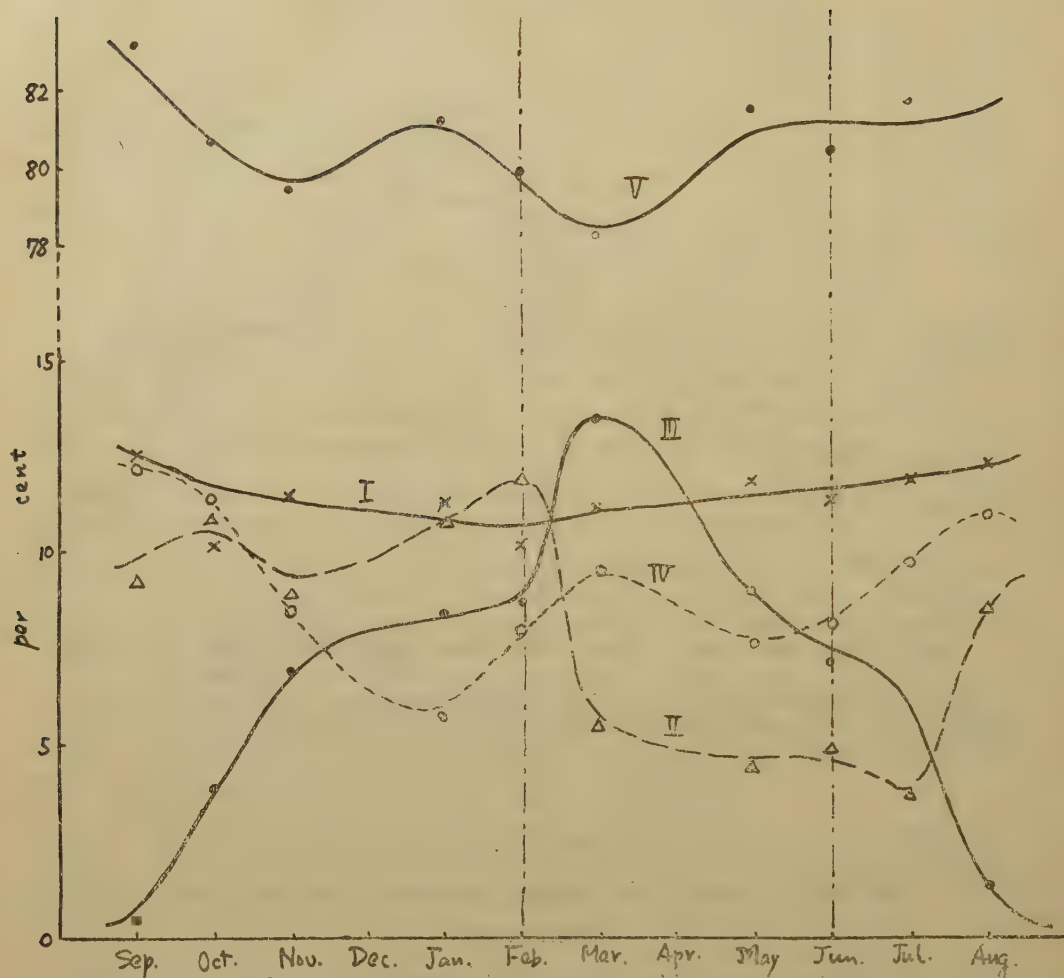


Fig. 3. The Monthly Changes in the Chemical Constituents of the Pearl Oyster (in Percentage). Curve I: Total nitrogen, II: Lipids, III: Glycogen and IV: Total ash, to Dried meat. Curve V: Water (to Fresh meat).

Table IV.

The Monthly Changes in the Chemical Constituents of Body without Adductor Muscle (in Weight).

	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.	Aug.
	g	g	g	g	g	g	g	g
Fresh meat	3.90	6.76	7.20	7.15	8.54	8.82	6.70	3.42
Water	3.13	5.61	5.86	5.70	7.15	7.13	5.54	2.78
Dried meat	0.77	1.15	1.33	1.30	1.44	1.68	1.16	0.62
Total nitrogen	0.087	0.130	0.136	0.151	0.170	0.191	0.133	0.071

Crude protein	0.542	0.812	0.848	0.945	1.060	1.192	0.828	0.441
Lipids	0.081	0.127	0.157	0.104	0.096	0.111	0.059	0.065
Glycogen	0.037	0.093	0.106	0.073	0.059	0.034	0.041	0.004
Total ash	0.070	0.080	0.131	0.154	0.131	0.149	0.130	0.079

Table V.

The Monthly Changes in the Chemical Constituents of Adductor Muscle
(in Weight).

	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.	Aug.
	g	g	g	g	g	g	g	g
Fresh meat	1.58	2.55	3.08	2.95	3.57	3.04	2.14	1.07
Water	1.21	1.92	2.37	2.40	2.80	2.42	1.70	0.83
Dried meat	0.37	0.63	0.72	0.70	0.73	0.64	0.44	0.24
Total nitrogen	0.043	0.066	0.073	0.073	0.085	0.072	0.053	0.032
Crude protein	0.267	0.417	0.455	0.456	0.532	0.449	0.340	0.201
Lipids	0.021	0.061	0.022	0.020	0.017	0.019	0.009	0.010
Glycogen	0.040	0.057	0.081	0.171	0.084	0.127	0.061	0.007
Total ash	0.024	0.025	0.041	0.043	0.040	0.040	0.030	0.020

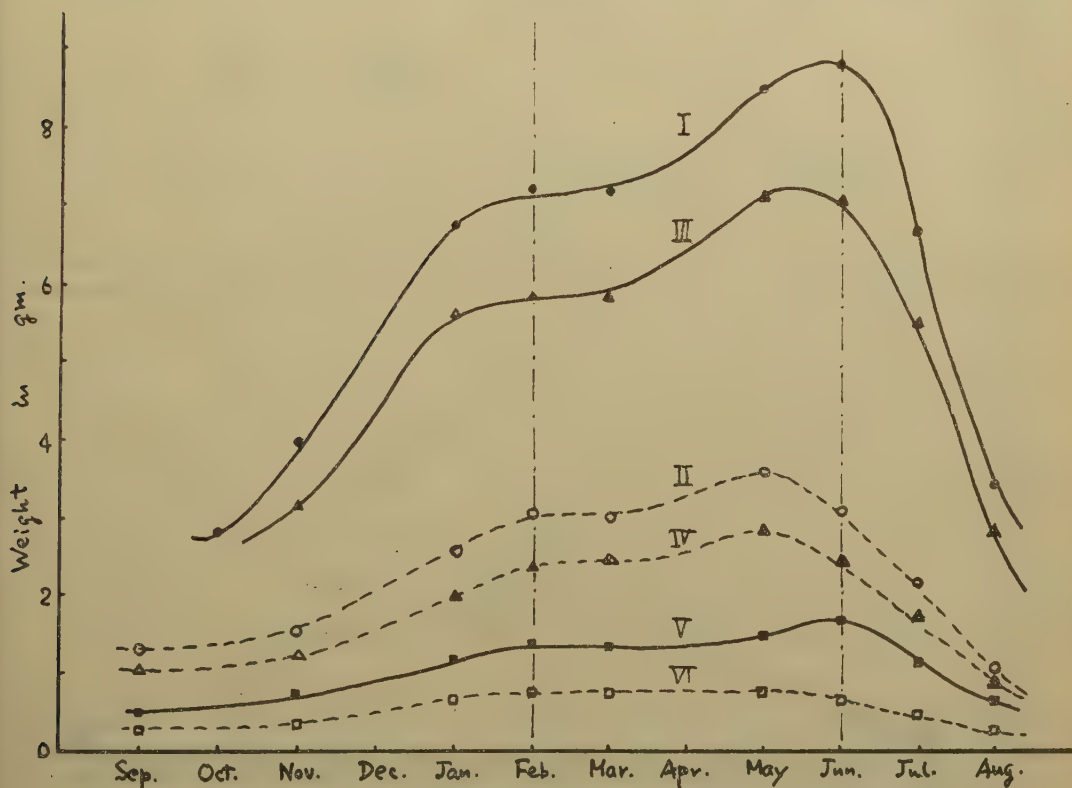


Fig. 4. The Monthly Changes in the Weight of Adductor Muscle and Total Other Parts of the Body of the Pearl Oyster. Curve I; Fresh meat in Body, II: Fresh meat in Adductor Muscle, III: Water in Body, IV: Water in Adductor Muscle, V: Dried meat in Body and VI; Dried meat in Adductor Muscle.

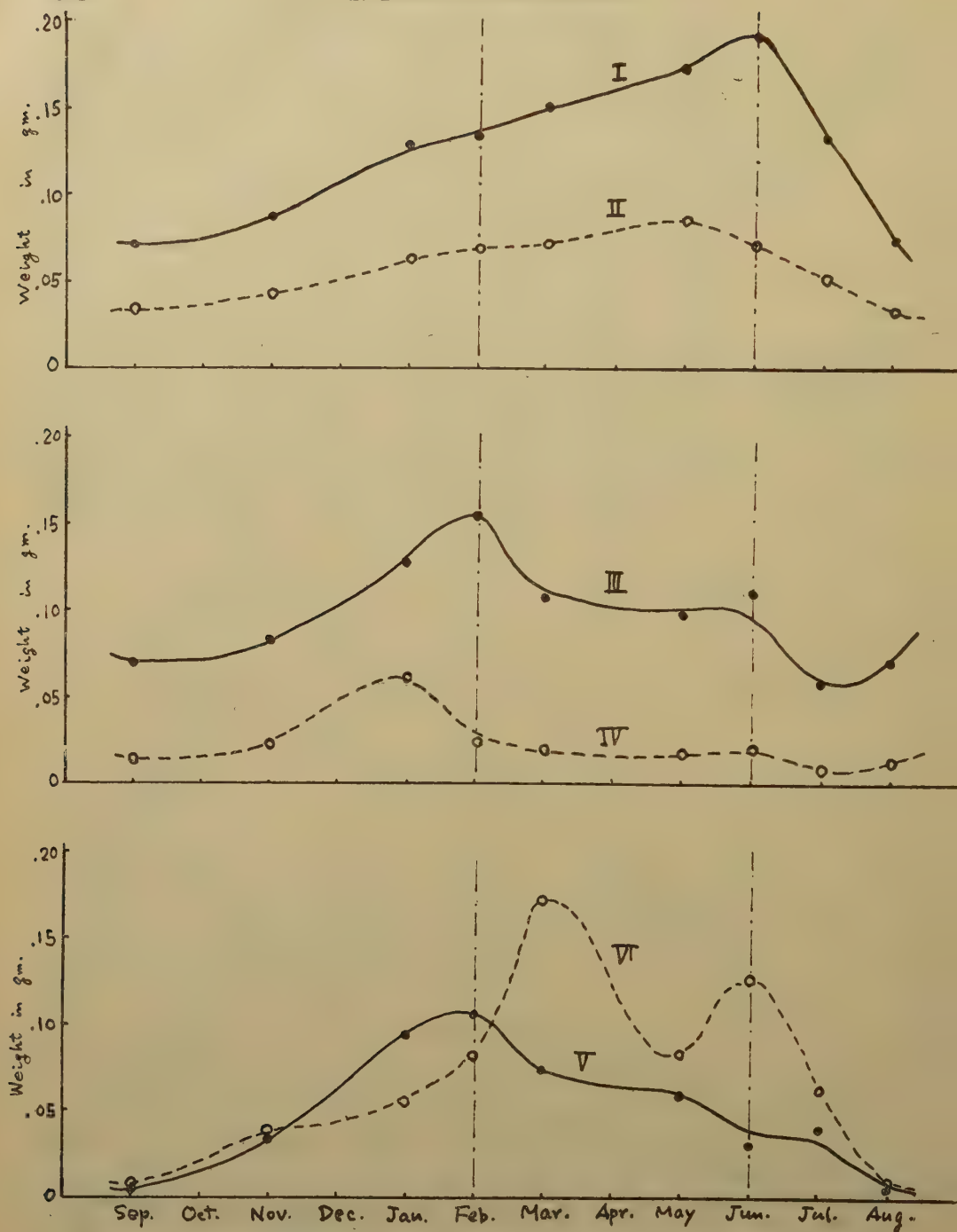


Fig. 5. The Monthly Changes in the Weight of Total Nitrogen, Lipids and Glycogen of the Adductor Muscle and Total Other Parts of the Body of the Pearl Oyster. Curve I; Total nitrogen in Body, II: Total nitrogen in Adductor Muscle, III: Lipids in Body, IV: Lipids in Adductor Muscle, V: Glycogen in Body and VI: Glycogen in Adductor Muscle.

Table VI.

The Monthly Changes in the Chemical Constituents of Body without Adductor Muscle
(in Percentage).

	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.	Aug.
	%	%	%	%	%	%	%	%
Water	80.22	82.95	81.44	80.65	83.05	80.86	82.69	81.88
Dried meat	19.78	17.04	18.56	19.34	16.95	19.14	17.31	18.12
Total nitrogen	11.26	11.30	10.20	11.63	11.78	11.36	11.43	11.38
Crude protein	70.40	70.63	63.75	72.65	73.60	71.00	71.40	71.15
Lipids	10.51	11.03	11.82	8.03	6.69	6.58	5.10	10.52
Glycogen	4.81	8.07	7.93	5.58	4.07	2.02	3.51	0.56
Total ash	9.04	6.99	9.84	11.87	9.11	8.85	11.19	12.67

Table VII.

The Monthly Changes in the Chemical Constituents of Adductor Muscle
(in Percentage).

	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.	Aug.
	%	%	%	%	%	%	%	%
Water	76.31	75.31	76.98	75.31	79.22	79.62	79.32	77.35
Dried meat	23.69	24.68	23.01	24.69	20.78	20.38	20.68	22.65
Total nitrogen	11.56	10.41	10.11	10.41	11.65	11.21	12.10	13.36
Crude protein	72.25	65.15	63.20	65.15	72.85	70.10	75.65	83.50
Lipids	5.63	9.59	2.98	2.83	2.27	3.01	2.01	4.31
Glycogen	10.93	8.95	11.29	24.38	11.45	19.82	13.81	3.05
Total ash	6.36	3.98	5.65	6.15	5.44	6.23	6.84	8.14

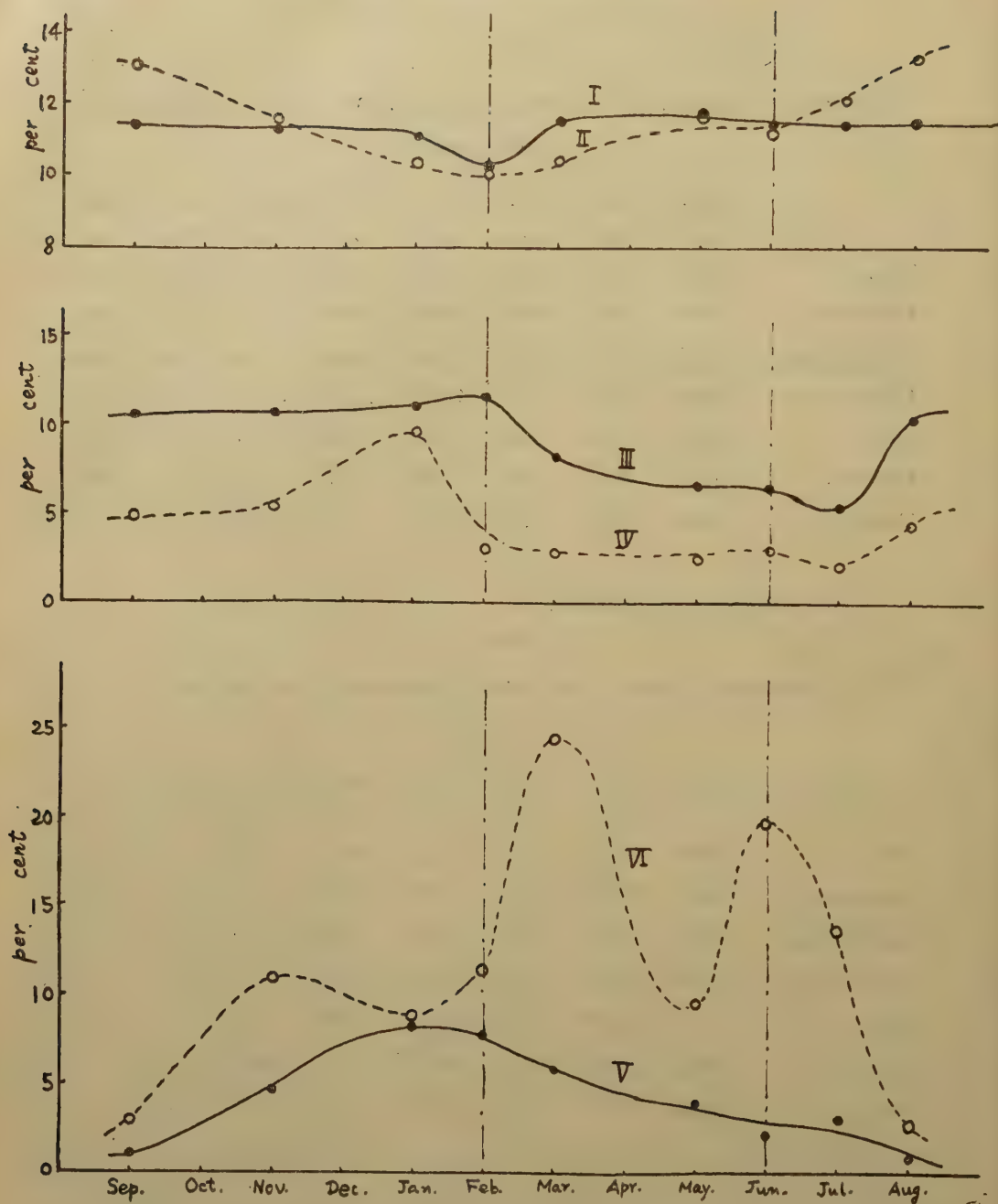


Fig. 6. The Monthly Changes in Percentage of Total Nitrogen, Lipids and Glycogen of the Adductor Muscle and Total Other Parts of the Body of the Pearl Oyster. Curve I: Total nitrogen in Body, II: Total nitrogen in Adductor Muscle, III: Lipids in Body, IV: Lipids in Adductor Muscle, V: Glycogen in Body and VI: Glycogen in Adductor Muscle.

Seasonal changes in protein content, which is the main component of the meat and of the adductor muscle, were found to be less striking than those occurring in other components, such as glycogen and lipids.

In the beginning of the fattening period the storage of glycogen is very remarkable. Notwithstanding that only trace glycogen was contained in September it increased rapidly and reached its maximum content (15 %) at the end of the fattening period. Especially in February glycogen was observed to be accumulated in the meat (except the adductor muscle) and then transferred into the adductor muscle in March. In contrast to the continuous increase in meat, glycogen begins to decrease gradually till May or June. From these facts certain active substances required for reproduction may be produced in this ripening period with the energy evolved from the oxidation of glycogen.

Lipids were also observed to be accumulated in the fattening period and reach maximum content in January in the adductor muscle and in February in the meat respectively. It is supposed from the facts that like glycogen lipids are utilized as sources of energy required for reproductive activities. The variation curves of lipids and glycogen suggest that transformations of lipids to glycogen may take place in the mollusk.

In contrast to the near-exhaustion of glycogen at the end of the ripening period, definite amounts of the lipids were noticed as still remaining. These constant lipids are presumed to have some physiological significance.

The results of analysis of the adductor muscle show that this organ serves not only to open and to shut the shell but also as a storage device of the oyster.

In contrast to the decrease of ash content a remarkable increase in shell weight was observed in the autumn. The season of pearl formation in the oyster is supposed to coincide with this season.

The seasonal changes in calcium, magnesium, iron, potassium, sodium, phosphate, chloride and sulphate content are shown in Table VIII and IX and also Fig. 7 and 8.

Table VIII.

The Monthly Changes in the Inorganic Constituents of the Pearl Oyster.
(in Weight).

	Sep.	Oct.	Nov.	Jan.	Feb.	Mar.	May	Jun.	Jul.	Aug.
	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
P ₂ O ₅	8.3	12.2	11.9	12.0	18.4	20.7	15.4	20.2	19.0	12.9
CaO	7.3	7.8	9.7	11.0	17.0	18.3	16.6	21.1	16.5	10.6
MgO	4.3	5.0	5.6	5.9	9.5	11.1	8.1	10.8	8.1	4.1
Fe ₂ O ₃	1.2	1.2	1.6	2.0	4.1	6.2	4.2	4.3	3.5	1.4

K ₂ O	12.7	14.4	14.7	14.9	21.5	25.9	22.4	29.2	23.7	14.5
Na ₂ O	5.6	6.8	6.5	7.2	11.5	14.4	12.3	14.3	11.6	7.1
Cl	29.9	33.0	36.4	37.8	61.7	69.1	63.7	73.7	56.8	33.6
SO ₄	5.0	5.9	7.6	7.8	13.9	13.9	8.0	8.1	8.1	5.4

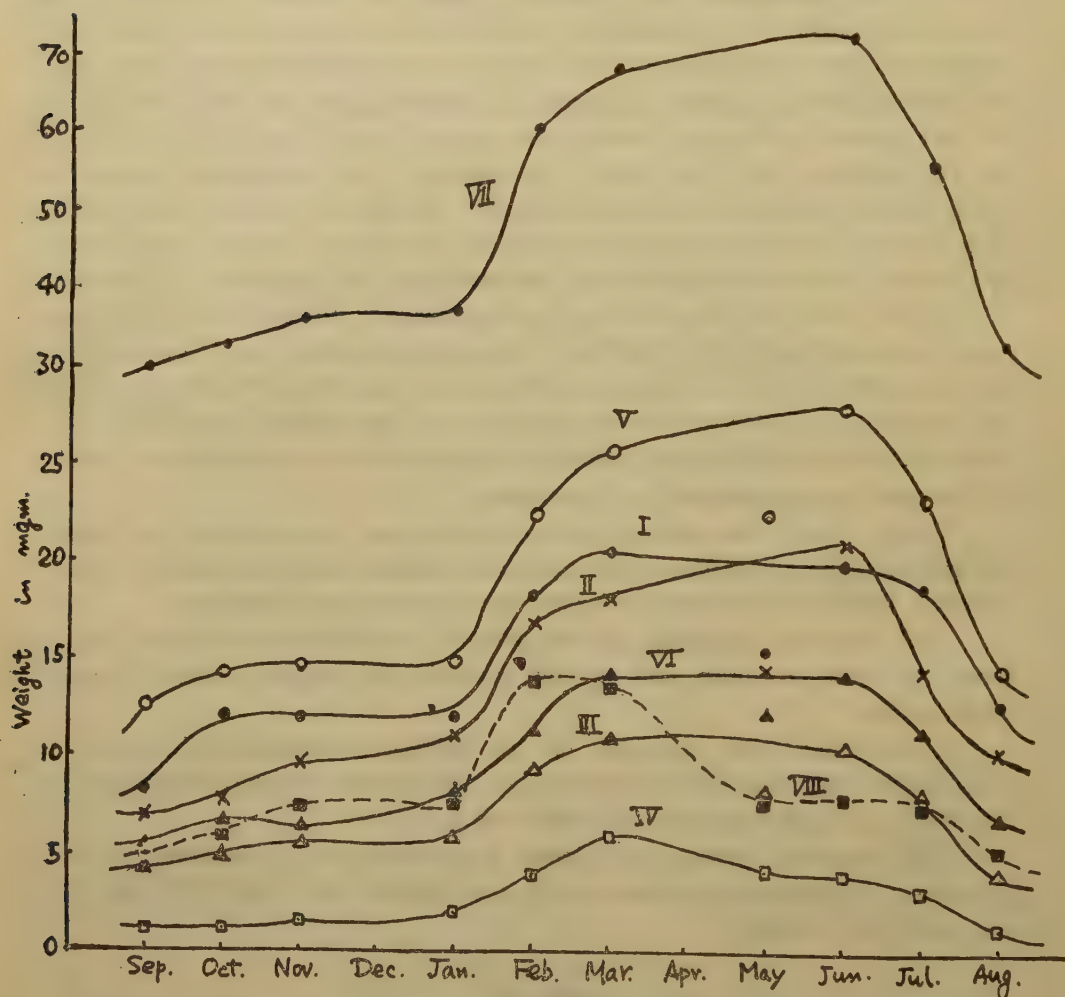


Fig. 7. The Monthly Changes in the Inorganic Constituents of the Pearl Oyster (in Weight). Curve I: Phosphate, II: Calcium, III: Magnesium, IV: Iron, V: Potassium, VI: Sodium, VII: Chloride and VIII: Sulphate.

Table IX.

The Monthly Changes in the Inorganic Constituents of the Pearl Oyster (in Percentage).

	Sep.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
P ₂ O ₅	13.83	13.86	12.43	11.93	11.57	11.00	10.52	9.52	10.67	12.37	13.71
CaO	9.48	8.80	10.12	10.85	10.47	9.93	10.53	10.21	11.16	10.71	11.26

MgO	5.59	5.70	5.80	5.80	5.87	5.90	5.15	4.98	5.68	5.26	4.32
Fe ₂ O ₃	1.51	1.40	1.65	2.01	2.55	3.27	2.64	2.56	2.28	2.27	1.47
K ₂ O	16.45	16.37	15.30	14.79	13.28	13.79	13.13	13.81	15.45	14.45	15.48
Na ₂ O	7.27	7.76	7.32	7.09	7.08	7.65	7.71	7.60	7.58	7.55	7.54
Cl	38.80	37.52	37.95	37.46	38.09	36.78	37.12	39.35	39.00	36.92	35.78
SO ₄	6.46	6.75	7.89	7.08	8.56	7.41	6.42	4.94	4.28	5.24	5.76

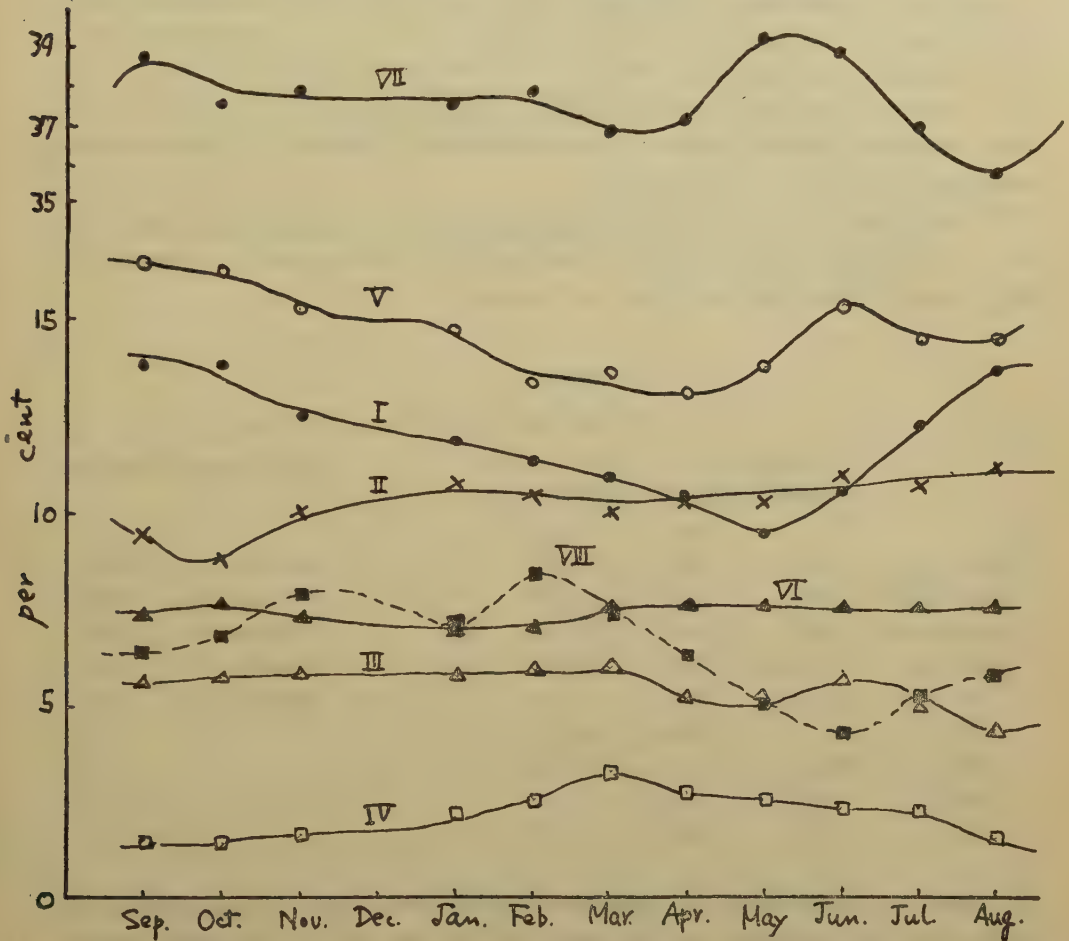


Fig. 8. The Monthly Changes in the Inorganic Constituents of the Pearl Oyster (in Percentage). Curve I: Phosphate, II: Calcium, III: Magnesium, IV: Iron, V: Potassium, VI: Sodium, VII: Chloride and VIII: Sulphate.

Total ash content of the pearl oyster increased from the reproductive period to the beginning of the fattening period. The changes in potassium and phosphate content also agreed with that of the total ash content. These facts suggest that these elements may be related to sexual activity.

From February to March the amount of iron reached a maximum. Since this element has been known as the component of the respiratory enzymes, it may play some significant role in the transformation of certain organic substances such as glycogen and lipids, in the pearl oyster.

It has already been known that taurin, an amino sulphuric acid, is the characteristic substance of the mollusks (9). The content of sulphate may be connected with taurin and other sulphuric esters of carbohydrate (10) which compose the mucus.

Sodium, magnesium and chloride are less variable at the content. The content of calcium in the meat was observed to decrease in the autumn when the shell grew in this season.

From the analytical results of the pearl, mother-of-pearl of the shell and the mucus of the pearl oyster, non-cooperation of phosphate is inferred in the process of calcification of the pearl oyster. (see Table X).

Table X.

Analytical Results of Pearl, Shell and Mucus of the Pearl Oyster

	Pearl (11)		Shell (1)	Mucus & Mantle Cords(12)	
	(superior)	(inferior)	(mother-of pearl)		
	%	%	%		%
Water	0.66	0.85	0.64	Total ash	23.31
Total nitrogen	0.72	1.33	0.84	Calcium oxide	1.45
Crude protein	4.50	8.31	5.26	Magnesium	0.74
Total ash	92.64	91.85	93.19	Sulphate	2.78
SiO ₂	0.40	0.51	—	Phosphate	0.62
CaO	56.33	54.83	57.00		
(CaCO ₃)	(100.4)	(97.7)	(92.92)		
MgO	0.97	0.79	—		
P ₂ O ₅	trace	trace	trace		

In stead of cooperation of phosphate in the vertebrate, transportation of calcium at the formation of the pearl and of the shell in the pearl oyster would be carried on with participation of certain proteins of acidic nature in the mucus sécreted from mucus cell of mantle cords.

The authors wish to express their hearty thanks to Prof. D. MIYADI and the members of the Seto Marine Biological Laboratory, Kyoto Univ., and also to Dr. Y. MATSUI, the chief of the Nippon Institute for Scientific Research on Pearl, for their kind helps in these experiments.

BIBLIOGRAPHY

- (1) J. OGUSHI, "Studies on Pearl", (in Japanese), (1938).
- (2) A. R. CAHN, "Pearl Culture in Japan", G.H.Q., N.R.S. Report No. 122, (1949).
- (3) S. TANAKA and H. HATANO, J. Chem. Soc. Japan, (in press).
- (4) "Method of Analysis of the Association of Official Agricultural Chemist", (1932).
- (5) F. PREGL, "Die Quantitative Organische Mikroanalyse", S. 105, (1935).
- (6) A. C. BROWNE, "Handbook of Sugar Analysis", p. 578, (1912); "Sugar Analysis", p. 867, (1948).
- (7) S. MORI, Jap. J. Malac. (in Japanese), 15, 46, (1948).
- (8) G. KLEIN, "Handbuch der Pflanzenanalyse", (1932).
- (9) OTANI and FUJIKAWA, "Chemistry of Mollusks", (in Japanese), p. 41, (1934).
- (10) T. SODA et al., J. Chem. Soc. Japan, 57, 981, (1936); *ibid.*, 61, 683, (1940); Bull. Chem. Soc. Japan, 13, 652, (1938).
- (11) S. TANAKA and H. Hatano, J. Chem. Soc. Japan, (in press).
- (12) OKUDA and TAKEUCHI, J. Chem. Soc. Japan, 38, 819, (1919).

LIST OF PUBLICATIONS

BASED ON THE RESULTS OF RESEARCHES CARRIED OUT AT
THE SETO MARINE BIOLOGICAL LABORATORY
DURING THE PERIOD FROM 1922 TO 1951

(Exclusive of papers not referred to marine biology)

In the following pages the titles of papers in the field of marine biology and oceanography based wholly, or in part, on works done at the Seto Marine Biological Laboratory of Kyoto University are given. As thirty years have elapsed since the foundation of the Marine Biological Laboratory at Sirahama, Wakayama Prefecture, the present time seems suitable to issue such a list as a summary of the scientific activities of the Laboratory.

A numbered series of articles and reports contained in this list which are put in brackets indicate the *Contributions* appeared in various publications of foreign languages and those put in parentheses indicate the *Contributions published in Japanese*. All translations and explanations of the latter, added by the present compiler, are enclosed in brackets. Both series of Contributions have been currently distributed for exchange. But, those marked with an asterisk * are now out of print or restricted only in stock, so that no longer available for exchange. A separate list of these numbers may be obtained on request, if still available.

March 1952

H. UTINOMI

1922 (大正 11 年)

Contribution number (in bracket)
(* not available for exchange)

- KOMAI, Taku [駒井卓]: 故池田岩治博士 [The late Dr. Iwaji Ikeda.] 動物雜 [Zool. Mag.], 34 (410), pp. 984-988, pl. 31.
- MIYASHITA, Yoshinobu [宮下義信]: 奇なるイソギンチャク類の一幼蟲 [A curious actinian larva.] *Ibid.*, 34 (408), pp. 861-863.

1923 (大正 12 年)

- IKARI, Jiro [井狩二郎]: 瀬戸臨海研究所七月の記事 [Notes from the Seto Marine Biological Laboratory in July.] 動物雜 [Zool. Mag.], 35 (417-422), pp. 521-523.
- : On the nuclear and cell division of a plankton-diatom *Coscinodiscus subbuliens*, Jörgensen. (Preliminary note.) *Bot. Mag.*, 37 (439-444), pp. 96-108, pls. 3 & 4.
- KOMAI Taku [駒井卓]: 京都大學瀬戸臨海研究所 [Seto Marine Biological Laboratory of the Kyoto University.] 動物雜 [Zool. Mag.], 35 (416), pp. 258-267.

1924 (大正 13 年)

- ESAKI, Teiso: On the curious halophilous water-strider, *Halovelis maritima* Bergroth (Hemiptera: Geriidae). *Bull. Brooklyn Ent. Soc.*, 19, pp. 29-34.
- : On the genus *Halobates* from Japanese and Formosan coast. *Psyche*, 31 (2), pp. 112-118, 1 pl.
- IKARI, Jiro [井狩二郎]: 或櫛水母類の固定 [A fixing method of certain ctenophores.] 動物雜 [Zool. Mag.], 36 (433), pp. 488-489.
- : 京大瀬戸臨海研究所彙報 [Miscellaneous reports of the Seto Marine Biological Laboratory of the Kyoto Univ.], *Ibid.*, 36 (433), pp. 494-495.

1925 (大正 14 年)

- IKARI, Jiro [井狩二郎]: *Chaetoceras Eibenii*, Grun = 就テ [On *Chaetoceras Eibenii*, Grun.] 植物雜 [Bot. Mag.], 33 (458), pp. 52-59. (With English rés.)
- MIYASHITA, Yoshinobu [宮下義信]: わが近海のトルナリアに就て [Ueber *Tornaria*-Larven aus Japanischen Küste.] 動物雜 [Zool. Mag.], 37 (438), pp. 170-177, pl. 2. (Mit deutsche Ztg.)
- UENO, Masuzo [上野益三]: タカアシガニの胃 [Stomach of the giant crab, *Macrocheira kaempferi*.] *Ibid.*, 37 (436), pp. 76-80.

1926 (大正 15 年)

- ESAKI, Teiso: The water-striders of the subfamily Halobatinae in the Hungarian National Museum. *Ann. Mus. Nat. Hungarici*, 23, pp. 117-164.
- IKARI, Jiro [井狩二郎]: On some *Chaetoceras* of Japan. I. *Bot. Mag.*, 49 (478), pp. 517-534. [* 2]
- : あらめの游走子培養に就て [On the culture of swarmspores of *Ecklonia bicyclis* Kjellm.] 水産雑 [Jour. Fish.], No. 29, pp. 13-16, pl. 1.
- UCHIDA, Tohru [内田亨]: 京大瀬戸臨海研究所の鉢水母 [Scyphostomae preserved in the Seto Marine Biological Laboratory.] 動物雑 [Zool. Mag.], 38 (457), pp. 383-384.

1927 (昭和 2 年)

- IKARI, Jiro: On *Bacteriastrum* of Japan. *Bot. Mag.*, 41 (486), pp. 421-432. (With Japanese rés.)
- : A list of Foraminifera found in the bottom-sand, which was collected at Misaki. *Jour. Fish.*, No. 30, pp. 9-16, pls. 1 & 2.
- KOMAI, Taku: Stomatopoda of Japan and adjacent localities. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 3 (3), pp. 307-354, pls. 13 & 14. [* 3]
- KOMAI, T., AKATSUKA, K. & IKARI, J.: The Seto Marine Biological Laboratory of the Kyoto Imperial University. Its equipment and activities, with remarks on the fauna and flora of the environs. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 3 (3), pp. 281-306, pl. 12. [* 1]
- OHSHIMA, Hiroshi [大島廣]: Notes on some pycnogons living semiparasitic on holothurians. *Proc. Imp. Acad.*, 3 (9), pp. 610-613. [* 4]
- : 海鼠に附着して生活する海蜘蛛に就いて [Piknogonoj alkroĉigantaj al Holuturioj.] 九大農學部學藝雜誌 [Bull. Sci. Fak. Terkultura, Kjuŝu Imp. Univ.], 2 (5), pp. 380-388, pl. 7. (With Esperanto rés.)
- UCHIDA, Tohru: Studies on Japanese Hydromedusae. I. Anthomedusae. *Jour. Fac. Sci. Imp. Univ. Tokyo*, Sect. IV, Zool., 1 (3), pp. 145-241, pls. 10 & 11.

1928 (昭和 3 年)

- AKATSUKA, Kozo (赤塚孝三): 海の植物 [Plants in the sea.] 海の科學 (日本兒童文庫, 46) [Science of the sea (Boys Library of Japan, No. 46)], pp. 159-238. アルス社 [Ars Book Co.], Tokyo.
- IKARI, Jiro [井狩二郎]: On some *Chaetoceras* of Japan. II. *Bot. Mag.*, 42 (497), pp. 247-262. [* 5]
- : 海藻まつもノ游走子發生ニ就キテ [On the culture of swarmspores of *Hetero-*

chordaria abietina (Rupr.) S. et G.] 植物雑 [Bot. Mag.], 42 (500), pp. 412-419. (With English rés.)

KOMAI, Taku [駒井卓]: 京都帝國大學理學部附屬瀬戸臨海研究所 [Seto Marine Biological Laboratory, College of Science, Kyoto Imperial University.] 理科教育 [Science Education], 11 (6), pp. 1-10.

———: 海の動物 [Animals in the sea.] 海の科學 (日本兒童文庫, 46) [Science of the sea (Boys Library of Japan, No. 46)], pp. 87-157. アルス社 [Ars Book Co.], Tokyo.

STIASNY, Gustav: Tornarien von Japan. [Unter Benutzung eines Manuscriptes und zahlreicher Zeichnungen von Yoshinobu Miyashita (Tokyo).] Zool. Jahrb., Abt. Syst., 56 (1), pp. 67-92.

TAKI, Iwao [瀧巖]: 貝類雜記 [Notes on shells.] Venus, 1 (1), pp. 27-32.

UCHIDA, Tohru: Studies on Japanese Hydromedusae. 2. Trachomedusae and Narcomedusae. Jap. Jour. Zool., 2 (1), pp. 73-97.

1929 (昭和 4 年)

ESAKI, Teiso: A remarkable speo-halophilous water-strider (Heteroptera, Mesoveliidae). Ann. Mag. Nat. Hist., Ser. 10, 4, pp. 341-346. [* 12a]

IKARI, Jiro: Notes on the diatoms found in the stomach contents of Japanese oysters. Proc. 4th Pacific Sci. Congress, Java, pp. 239-244. [* 10]

IWATA, Masatoshi [岩田正俊]: 瀬戸産 *Nausitoë* sp. の Scyphula stage に就きて (豫報) [On the scyphula stage of *Nausitoë* sp. from Seto. (Preliminary note)] 動物雑 [Zool. Mag.], 41 (490-491), pp. 364-365.

KOMAI, Taku [駒井卓]: 京都帝國大學理學部瀬戸臨海研究所 [Seto Marine Biological Laboratory, College of Science, the Kyoto Imperial University.] 21 pp., 8 pls. Publ. by the Laboratory.

KOMAI, Taku & IKARI, Jiro: The Seto Marine Biological Laboratory of the Kyoto Imperial University. Its equipment and activities, with remarks on the fauna and flora of the environs. (A revised article.) Rec. Ocean. Wks. in Japan, 1 (3), pp. 113-129, pls. 27-35. [* 8]

KOMAI, Taku & TUNG, Yüh Mou: Notes on the larval stages of *Squilla oratoria* with remarks on some other stomatopod larvae found in the Japanese seas. Annot. Zool. Japon., 12 (1), pp. 187-237, pls. 1-9. [* 9]

KURODA, Tokubei [黒田徳米]: 日本産新貝類 (1) [New Japanese shells (1).] Venus, 1 (3), pp. 77-82, pl. 1.

———: 紀伊の貝類 [The Molluscan fauna of Prov. Kii.] Ibid., 1 (4), pp. 123-127.

ONODA, Katsuzo [小野田勝造]: 海膽の幼生の骨格 [Larval skeleton of some sea-urchins.] 動物雑 [Zool. Mag.], 41 (487), pp. 225-230.

- TAKI, Isao & TAKI, Iwao: Studies on Japanese chitons (1). *Venus*, 1 (2), pp. 47-54, pl. 2. (With Japanese rés.) [* 7]
- & ———: Studies on Japanese chitons (2). *Ibid.*, 1 (4), pp. 141-153, pl. 2. (With Japanese rés.) [* 11]
- & ———: Studies on Japanese chitons (3). *Ibid.*, 1 (5), pp. 157-164. (With Japanese rés.) [* 13]
- TAKI, Iwao: Notes on a 4-rayed specimen of *Clypeaster japonicus* Döderlein. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 4 (2), pp. 157-163, pl. 25. [* 6]
- UCHIDA, Tohru: Studies on the Stauromedusae and Cubomedusae, with special reference to their metamorphosis. *Jap. Jour. Zool.*, 2 (2), pp. 103-193, pls. 3-5.
- YAMANOUCHI, Toshihiko [山内年彦]: 二價金屬イオンの刺激につきて [On the stimulus of divalent metallic ions.] 動物雜 [Zool. Mag.], 41 (490-491), p. 421-422.
- YUASA, Hachiro: An ecological note on *Spicovelia marilima*, Esaki. *Ann. Mag. Nat. Hist.*, Ser. 10, 4, pp. 346-349. [* 12b]

1930 (昭和 5 年)

- HIRASE, Shintaro: On the classification of Japanese oysters. *Jap. Jour. Zool.*, 3 (1), pp. 1-65.
- KINOSHITA, Toraichiro [木下虎一郎]: 紀州雜俎 [Kii miscellany.] 水産研究誌 [Jour. Fish. Res.], 25 (6), pp. 191-192.
- : 田邊灣に産する方言「ヒゲナガエビ」[“Higenaga-ebi”, a prawn found in Tanabe Bay.] *Ibid.*, 25 (10), pp. 269-270.
- : 伊勢蝦類の標識に就て [On tagging of Japanese spiny lobsters.] *Ibid.*, 25 (12), pp. 334-335, 1 pl.
- KOMAI, Taku [駒井卓]: 御採集に陪して [Accompanying with the Emperor's shore collecting.] 駒井著: 生物學叢話 [T. KOMAI's "Stories on biology"], pp. 1-29, 2 pls. 改造社 [Kaizo-sha Book Co.], Tokyo.
- KOSHIMIZU, Takuji: Carpobiological studies of *Crinum asiaticum* L. var. *japonicum* Bak. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 5 (2), pp. 183-227, pls. 15 & 16. [* 14]
- TOKUNAGA, Masaaki: The morphological and biological studies on a new marine crane-fly, *Limonia (Dicranomyia) monstrosia*, from Japan. *Mem. Coll. Agr. Kyoto Imp. Univ.*, No. 10, pp. 1-93, pls. 1-17. [* 15]

1931 (昭和 6 年)

- HIRO, Fujio: Notes on some new Cirripedia from Japan. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 7 (3), pp. 143-158, pl. 11-14. [20a]

- KINOSHITA, Toraichiro [木下虎一郎]: 牡蠣ノ害敵トシテノ骨貝類 (豫報) [Muricid gastropods as enemies of oyster shells. (Preliminary note.)] 和歌山縣水試事業報告 [Prog. Rep. Wakayama Pref. Fish. Exp. Sta. for 1930], No. 27, pp. 43-50.
- : 伊勢蝦生態調査 [Ecological observations on *Panulirus japonicus*.] *Ibid.*, No. 27, pp. 52-58.
- : 和歌山縣沿岸で用ひらるる釣餌料としての甲殻類若干 [Some crustaceans used as fishing baits along the coast of Wakayama Prefecture.] 水産研究誌 [Jour. Fish. Res.], 26 (4), pp. 98-103.
- : 伊勢蝦の生態に関する二・三 [Some ecological notes on *Panulirus japonicus*.] *Ibid.*, 26 (7), pp. 231-236.
- KINOSHITA, Toraichiro & KINOSHITA Seichiro [木下虎一郎・木下清一郎]: 牡蠣の害敵としての骨貝類 (豫報) [On some muricid shells as enemies to the oyster (Preliminary report).] *Venus*, 2 (4), pp. 190-198.
- KOMAI, Taku [駒井卓]: 腔腸類 [Coelenterata.] 岩波講座, 生物學 [Iwanami Lecture Series, Biology.] 102 pp., 4 pls. 岩波書店 [Iwanami Book Co.], Tokyo.
- : On the hydroid stage of *Cytaeis japonica* Uchida. *Annot. Zool. Japon.*, 13 (3), pp. 255-258.
- KOMAI, Taku & TUNG, Yüh Mou: On some points of the internal structure of *Squilla oratoria*. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 6 (1), pp. 1-16, pls. 1 & 2. [* 17]
- KOMORI, Seichi: Einige Bemerkungen über die Biologie der Aktinie *Boloceroidea*. *Ibid.*, 7 (2), pp. 55-62, pl. 4. [20b]
- KURODA, Tokubei: New Japanese shells (3). *Venus*, 2 (6), pp. 314-318, pl. 1.
- : Two new species of Volutacea. *Ibid.*, 3 (1), pp. 45-49.
- ONODA, Katsuzo: Notes on the development of *Helicoidaris crassispina* with special reference to the structure of the larval body. *Ibid.*, 7 (3), pp. 103-134, pls. 5-7. [* 19]
- SHINO, Suetō M.: Studies on the modification of sexual characters in *Eupagurus samuelis* caused by a rhizocephalan parasite *Pellogaster* sp. *Ibid.*, 7 (2), pp. 63-101. [* 18]
- TAKI, Isao & TAKI, Iwao: Studies on Japanese chitons (5). *Venus*, 2 (4), pp. 178-185. (With Japanese rés.) [* 16]
- & ——— : Studies on Japanese chitons (6). *Ibid.*, 2 (5), pp. 215-220, pl. 7. (With Japanese rés.)
- YABE, Hisakatsu & SUGIYAMA, Toshio: A study of recent and semifossil corals of Japan. I. *Antillia* and 2. *Caulastraea*. *Sci. Rep. Tohoku Imp. Univ.*, 2nd Ser. (Geol.), 14 (2A).

1932 (昭和 7 年)

- ALEXANDER, C. P.: New or little known Tipulidae from eastern Asia (Diptera),
X. *Philip. Jour. Sci.*, 49 (1), pp. 105-136.
- HIRO, Fujio: Report of the Japanese species of the genus *Calantica* (Cirripe-
dia). *Annot. Zool. Japon.*, 13 (5), pp. 467-485, pl. 30. [31]
- : Report on the biological survey of Mutsu Bay. 25. Cirripedia. *Sci.*
Rep. Tohoku Imp. Univ., 4th Ser. (Biol.), 7 (4), pp. 545-552.
- INOH, Syumpei: Embryological studies on *Sargassum* and *Cystophyllum*. *Jour.*
Fac. Sci. Hokkaido Imp. Univ., Ser. 5, 1 (4), pp. 125-133.
- KINOSHITA, Toraichiro [木下虎一郎]: 伊勢蝦生態調査. V. 生物學的最小形; 自然界ニ於ケル
成長度ト移動 [Ecological observations on *Panulirus japonicus*. V. Its biologi-
cal minimum size; migration and growth-rate in the natural habitat.]
和歌山縣水試事業報告 [Prog. Rep. Wakayama Pref. Fish. Exp. Sta. for 1931],
No. 2², pp. 25-30.
- : 紀伊沿岸の底棲貝類 [The dredged shells from the coast of Prov. Kii.]
Venus, 3 (5), pp. 251-259.
- : 紀州雜俎 (其 2) [Kii miscellany, 2.] 樂水會誌 [*Rakusui Kaisi*], 27 (5), pp.
41-47, 5 pls.
- : 和歌山縣下に起つた渦蟲類に因る牡蠣の被害 [The damage of oysters by the
attack of turbellarians occurred in Wakayama Pref.] *Ibid.*, 27 (7), p. 3.
- KOMAI, Taku: An enormous swarm of stomatopod larvae. *Annot. Zool. Japon.*,
13 (4), p. 351-354. [* 23]
- : On two species of athecate hydroids associated with scorpaenoid
fishes. *Ibid.*, 13 (5), pp. 445-459, pls. 26-28. [* 30]
- : On some *Salpas* occurring in the vicinity of Seto, with remarks on
enantiomorphism found in some aggregated forms. *Mem. Coll. Sci. Kyoto*
Imp. Univ., Ser. B, 8 (1), pp. 65-80. [* 29]
- : 群棲鉢水母 *Stephanoscyphus*. [Aggregated scyphopolyp, *Stephanoscyphus*.]
動物雜 [Zool. Mag.], 44 (521), p. 89.
- KURODA, Tokubei [黒田徳米]: 標本同定餘録 (1) [Notes on some interesting shells
new to the Japanese fauna (1).] *Venus*, 3 (2), pp. 113-118.
- MORITA, Junichi [森田淳一]: Numerical ratio of the atypical to the typical
spermatozoa in *Viviparus* and several other Prosobranchiata. *Folia Anat.*
Jap., 10 (1), pp. 53-92.
- : タニシ (*Viviparus*), 其他數種の前鰓目 (Prosobranchiata) の異型精蟲に就て
[On the atypical spermatozoa of the genus *Viviparus*, and some other
Prosobranchiate mollusks.] *Venus*, 3(2), pp. 61-71, pl. 1.
- OKADA, Yô K.: Notes on parasitic Copepoda *Herpyllobius*. *Annot. Zool. Japon.*,
13 (4), pp. 407-415, pl. 24. [* 25]

- : Studies on regeneration of Coelenterata. 3rd part: Hydromedusae, *Charybdea* and *Coeloplana*. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 7(5), pp. 205-221.
- : Développement post-embryonnaire de la *Physalie* Pacifique. Appendice: Le Parasite de la *Physalie*. *Ibid.*, 8 (1), pp. 1-26, pl. 1. [* 27]
- OMORI, Nansaburo [大森南三郎]: 瀬戸四双島夜間採集に就いて [On the night flight of insects at the isle of Sisô-zima, Seto.] 動物雑 [Zool. Mag.], 44 (524), pp. 227-233.
- ONODA, Katsuzo [小野田勝造]: コシタカウエの幼生と其變態. 附 ウエ幼生の飼育に就いて [The larva of *Mespilia globulus* and its metamorphosis. Appendix: On the culture of echinoid larvae.] *Ibid.*, 44 (519-520), pp. 29-21.
- SHIINO, Suetō M.: *Ichthyotaces pteroisicola*, n. gen. & n. sp., a copepod parasitic on the fish *Pterois lunulata* Temm. & Schl. *Annot. Zool. Japon.*, 13 (4), pp. 417-433, pl. 25. [* 26]
- STEPHENSEN, K.: Some new amphipods from Japan. *Ibid.*, 13 (5), pp. 487-501.
- TAKI, Iwao [龍巖]: On some cases of abnormality of the shell-plates in chitons. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 8 (1), pp. 27-64, pl. 2. [* 28]
- : 貝類雜記 (4) [Malacological notes. (4)] *Venus*, 3 (4), pp. 206-216.
- TANAKA, Hideo [田中英雄]: Reorganization in regenerating pieces of *Coeloplana*. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 7 (5), pp. 223-246, pl. 18. [* 21]
- : *Coeloplana echinicola* n. sp. *Ibid.*, 7 (5), pp. 247-250, pl. 19. [* 22]
- : Remark on the viviparous character of *Coeloplana*. *Annot. Zool. Japon.*, 13 (4), pp. 399-405, pl. 23. [* 24]
- : *Coeloplana* の切斷再生片に於ける Axis の決定に就いて [On the determination of axis in regenerating pieces of *Coeloplana*.] 動物雑 [Zool. Mag.], 44 (519-520), pp. 55-56.
- : 瀬戸近海に於ける *Coeloplana* の發生初期に就いて [On the early development of *Coeloplana* found in the environs of Seto.] *Ibid.*, 44 (521), pp. 88-89.
- TOKUNAGA, Masaaki [徳永雅明]: Morphological and biological studies on a new marine chironomid fly, *Pontomyia pacifica*, from Japan. Part I. Morphology and taxonomy. *Mem. Coll. Agr. Kyoto Imp. Univ.*, No. 19, pp. 1-56, pls. 1-5.
- : A new biting midge from Japan (Diptera, Ceratopogonidae), with anatomical notes on the larval head-capsule and mouth-parts. *Trans. Kansai Ent. Soc.* No. 3, pp. 1-12.
- : 海棲昆蟲として特殊の進化を示せる搖蚊 *Pontomyia natans* Edwards 及び *P. pacifica* Tokunaga に就いて [On two marine chironomid flies, *Pontomyia natans* Edwards and *P. pacifica* Tokunaga, showing a specialized manner of evolution as marine insects.] 動物雑 [Zool. Mag.], 44 (519-520), pp. 67-69.

- : 紀州瀬戸海岸洞窟昆虫雑記 [Notes on the speophilous insects occurring along the coast of Seto, Prov. Kii.] 關西昆虫學會々報 [Trans. Kansai Ent. Soc.], No. 3, pp. 89-90.
- : 海棲昆虫 *Pontomyia pacifica* Tokunaga, (Chironomidae, Diptera) の幼生及び卵に及ぼす塩度の影響に就いて [On the effect of salinity on the larvae and eggs of a marine chironomid *Pontomyia pacifica* Tokunaga (Chironomidae, Diptera).] 日本學術協會報告 [Rep. Jap. Soc. Adv. Sci.], 7 (3), pp. 431-437.
- UCHIDA, Tohru: Occurrence in Japan of *Diadumene Luciae*, a remarkable actinian of rapid dispersal. *Jour. Fac. Sci. Hokkaido Imp. Univ.*, Ser. 6, Zool., 2 (2), pp. 69-82, pl. 4.
- YABE, Hisakatsu & SUGIYAMA, Toshio: Reef corals found in the Japanese seas. *Sci. Rep. Tohoku Imp. Univ.*, 2nd Ser. (Geol.), 15 (2), pp. 143-168.

1933 (昭和 8 年)

- AKATSUKA, Kozo [赤塚孝三]: 浮游生物學概説 [Outline of planktology.] 岩波講座, 生物學 [Iwanami Lecture Series, Biology.] 71 pp. 岩波書店 [Iwanami Book Co.], Tokyo.
- ALEXANDER, C. P.: New or little-known Tipulidae from Eastern Asia (Diptera), XIII. *Philip. Jour. Sci.*, 51 (3), pp. 369-408.
- ESAKI, Teiso [江崎悌三]: 日本沿海に産する海産半翅類 [Marine water-striders (Hemiptera) from Japanese coasts.] 植物及動物 [Bot. & Zool.], 1 (6), pp. 771-784.
- HIRO, Fujio: Report on the Cirripedia collected by the surveying ships of the Imperial Fisheries Experimental Station on the continental shelf bordering Japan. *Rec. Ocean. Wks. in Japan*, 5 (1), pp. 11-84, pls. 1-3. [* 32]
- : Notes on two interesting pedunculate cirripeds, *Malacolepas conchicola* n. gen. et sp. and *Koleolepas avis* (Hiro), with remarks on their systematic positions. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 8 (3), pp. 233-247, pls. 8 & 9. [33]
- INO, Syumpei [猪野俊平]: フークス科植物の胚發生に就て [On the embryo-development of Fucaceae.] 植物及動物 [Bot. & Zool.], 1 (6), pp. 785-792.
- KINOSHITA, Toraichiro [木下虎一郎]: 伊勢蝦の蕃殖保護に關する二三の知見 [On the propagation of the spiny lobster, *Panulirus japonicus* (v. Siebold).] 日本水産雜 [Bull. Jap. Soc. Sci. Fish.], 1 (5), pp. 237-240, 1 pl. (With English rés.)
- : 紀伊瀬戸鉛山高島附近のタイドプール・アルチ [Algae in tide pools near Takasima at Seto-Kanayama, Prov. Kii.] 養殖會誌 [Jour. Aquiculture], 3 (5), pp. 82-84.

- KOMAI, Taku: Notes on Semper's larvae found in the vicinity of Seto. *Annot. Zool. Japon.*, 14 (1), pp. 67-77, pl. 4. [* 36]
- KOSHIMIZU, Takuji [小清水卓二]: 日本産ハマオモト (*Crinum asiaticum* L. var. *japonicum* Bak.) の種質生態學的研究 [Carpobiological studies of *Crinum asiaticum* L. var. *japonicum* Bak.] 植物及動物 [Bot. & Zool.], 1 (11), pp. 1569-1578.
- OKADA, Yô K.: Two interesting syllids, with remarks on their asexual reproduction. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 8 (3), pp. 325-338, pl. 12. [* 35]
- ONODA, Katsuzo: On the orientation of the regular sea-urchin *Heliocidaris crassispina*. *Jap. Jour. Zool.*, 5 (2), pp. 159-164.
- SHINO, Sueo M. [椎野季雄]: Bopyrids from Tanabe Bay. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 8 (3), pp. 249-300. [* 34]
- : 瀬戸臨海研究所水族館 [Aquarium of the Seto Marine Biological Laboratory.] 博物館研究 [Museum Studies], 6 (10), pp. 5-6.
- TAKAYA, Hiroshi: A note on the abnormal nuclear division of the normally fertilized eggs of the echinoid (*Anthocidaris crassispina*) in acid media. *Annot. Zool. Japon.*, 14 (1), pp. 103-108. [* 37]
- TAKI, Iwao [瀧巖]: 貝類雜記 (5) [Malacological notes (5)]. *Venus*, 3 (6), pp. 346-358.
- TOKUNAGA, Masaaki: A marine crane-fly, *Limonia* (*Dicranomyia*) *trifilamentosa*, of the Pacific coast of Japan. *Philip. Jour. Sci.*, 50 (3), pp. 327-342.
- : Chironomidae from Japan (Diptera). I. Clunioninae. *Ibid.*, 51 (1), pp. 87-99, pls. 1 & 2.
- : Chironomidae from Japan (Diptera). II. Marine *Tanytarsus*. *Ibid.*, 51 (3), pp. 357-367, pls. 1 & 2.
- YAMAGUCHI, Satyu: Studies on the helminth fauna of Japan. Part 2. Trematodes of fishes, I. *Jap. Jour. Zool.*, 5 (3), pp. 249-541.

1934 (昭和 9 年)

- FAUVEL, Pierre: Sur quelques Syllidiens du Japon. *Annot. Zool. Japon.*, 14 (3), pp. 301-315. [* 39]
- HIRO, Fujio: A new coral-inhabiting barnacle, *Pyrgoma orbicellae* n. sp. *Proc. Imp. Acad.*, 10 (6), pp. 367-369.
- KINOSHITA, Toraichiro [木下虎一朗]: On the artificial propagation of *Panulirus japonicus* (de Haan) and some account of its larvae. *Proc. 5th Pacific Sci. Congress, Victoria and Vancouver, B.C., Canada*. 1933.
- : 伊勢蝦の Puerulus と其後の變態に就きて [Studies on puerulus of spiny

- lobster, *Panulirus japonicus* (v. Siebold), and its later metamorphosis.] 動物雑 [Zool. Mag.], 46 (551), pp. 391-399; 和歌山縣水試事業報告 [Prog. Rep. Wakayama Pref. Fish. Exp. Sta.], No. 29, pp. 48-52, 1 pl.
- KOMAI, Taku [駒井卓]: On the structure of *Ctenoplana*. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B. 9 (4), pp. 245-256. [40b]
- : *Ctenoplana* の体制に就て [On the structure of *Ctenoplana*.] 動物雑 [Zool. Mag.], 46 (545), pp. 107-108.
- OKADA, Yō K.: *Amblyosyllis nigrolineata*, une nouvelle variété de l'*A. speciosa* Izuka. Annot. Zool. Japon., 14 (3), pp. 317-320. [* 40a]
- OKAMURA, Kintaro [岡村金太郎]: 和歌山縣瀬戸鉛山及附近ノ海藻 [Notes on the Algae collected near Seto kanayama. Pref. Wakayama.] 植研雑 [Jour. Jap. Bot.], 10 (3), pp. 149-166.
- : 本邦産てんぐさ屬とおぼくさ屬ニ就テ [On *Gelidium* and *Pterocladia* of Japan.] 水講研究報告 [Jour. Imp. Fish. Inst.], 29 (2), pp. 47-67, pls. 16-33. (English and Japanese articles.)
- ONODA, Katsuzo [小野田勝造]: 海膽の幼生と交雑實驗 [Echinoid larvae and their hybridization experiment.] 動物雑 [Zool. Mag.], 46 (545), pp. 90-91.
- SHINO, Suetō M. [椎野季雄]: Bopyrids from Tanabe Bay. II. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B. 9 (4), pp. 257-287. [* 38]
- : 京都帝國大學理學部附屬瀬戸臨海研究所 [Seto Marine Biological Laboratory, College of Science, Kyoto Imperial University.] 科學 [Science], 4 (1), pp. 28-32.
- TOKUNAGA, Masaaki [徳永雅明]: 海棲ヒトヘグサカガンボの觀察 [Observations on a marine crane fly, *Limonia (Dicranomyia) monstrosia* Tokunaga (Diptera, Tipulidae).] むし [Mushi], 7 (2), pp. 90-86.
- : 紀州海岸に見られる蟻 [Ants found along the Kii coast.] 關西昆蟲雜誌 [Kansai Ent. Mag.], 2 (2), pp. 40-42.
- : 海棲昆蟲セトオヨギユスリカの週期的發生 [Periodic outbreak of a marine chironomid fly, *Pontomyia pacifica* Tokunaga.] Ibid., 2 (2), pp. 43-44.
- : 海洋性昆蟲「オヨギユスリカ」概説 [The genus *Pontomyia* Edwards.] 植物及動物 [Bot. & Zool.], 2 (8), pp. 1357-1364.
- YAMANOUCHI, Toshihiko [山内年彦]: 黒ナマコの表皮に及ぼす化學物質の影響 [On the effect of chemicals on the epidermis of the black sea-cucumber, *Ho'othuria* sp.] 動物雑 [Zool. Mag.], 46 (545), pp. 119-120.

1935 (昭和 10 年)

- HIRO, Fujio [弘富士夫]: A study of cirripeds associated with corals occurring in Tanabe Bay. Rec. Ocean. Wks. in Japan, 7 (1), pp. 45-72. [* 43]

- : The fauna of Akkeshi Bay. II. Cirripedia. *Jour. Fac. Sci. Hokkaido Imp. Univ.*, Ser. 6, Zool., 4 (4), pp. 213-229, pl. 10.
- : 青珊瑚と共棲するクロフヂツボ [*Tetracrita wireni*, a barnacle found commensal with the blue coral, *Heliopora coerulea*.] 科學 [Science], 5 (5), pp. 190-191.
- : 眞蓑脚類と他動物との共棲關係 [On the commensalism between the cirripeds and other animals.] 生態學研究 [*Ecol. Rev.*], 1 (4), pp. 343-344; 2 (1), pp. 58-65.
- KINOSHITA, Toraichiro [木下虎一郎]: 龍蝦ノ移動並ニ成長度調査 [Investigation on the migration and growth-rate of spiny lobster *Panulirus japonicus*.] 和歌山縣水試事業報告 [*Prog. Rep. Wakayama Pref. Fish. Exper. Sta.*], No. 30, pp. 45-50.
- KOMAI, Taku: On *Stephanoscyphus* and *Nausithoë*. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 10 (5), pp. 289-340, pls. 21 & 22. [* 41]
- MORITA, Junichi [森田淳一]: 休止核の構造に就て (第2報) [On the structure of the resting nucleus. (2nd Report).] 日本學術協會報告 [*Rep. Jap. Soc. Adv. Sci.*], 10 (4), pp. 991-999.
- OKADA, Yô K.: Les jeunes *Physalies*. Note supplémentaire sur le développement postembryonnaire de la *Physalie*. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 10 (5), pp. 407-410. [* 42]
- TAKI, Iwao: Two new species of *Oncidiella* from Japan (Pulmonata). *Venus*, 5 (2-3), p. 63-69, pl. 4.
- TOKUNAGA, Masaaki: Chironomidae from Japan (Diptera), IV. The early stage of a marine midge, *Telmatogeton japonicus* Tokunaga. *Philip. Jour. Sci.*, 57 (4), pp. 491-511. pls. 1-3. [* 44]
- : Chironomidae from Japan (Diptera), V. Supplementary report on the Clunioninae. *Mushi*, 8 (1), pp. 1-20, pls. 1-4. [* 45]
- YABE Hisakatsu & SUGIYAMA, Toshio: Geological and geographical distribution of reef-corals in Japan. *Jour. Paleont.*, 9 (3), pp. 183-217, pl. 21.
- & ——: Revised lists of the reef corals from the Japanese seas and of the fossil reef corals of the raised reefs and the Ryûkyû limestone of Japan. *Jour. Geol. Soc. Jap.*, 42 (502), pp. 379-403, pls. 10 & 11.
- YAMAGUTI, Satyu: Studies on the helminth fauna of Japan. Part 9. Nematodes of fishes. I. *Jap. Jour. Zool.*, 6 (2), pp. 338-386.

1936 (昭和 11 年) 、

- FAUVEL, Pierre: Annélides Polychètes du Japon. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 12 (1), pp. 41-92. [50]

- HIRO, Fujio [弘富士夫]: On the geographical distribution of *Ibla*, a littoral cirriped. *Bull. Biogeogr. Soc. Japan*, 6 (2), pp. 215-220. [* 53]
- : Descriptions of three new species of Cirripedia from Japan. *Ibid.*, 6 (2), pp. 221-230. [* 54]
- : Occurrence of the cirriped *Stomatolepas elegans* on a loggerhead turtle found at Seto. *Annot. Zool. Japon.*, 15 (3), pp. 312-320. [* 55]
- : Report on the Cirripedia collected in the Malayan waters by the ship 'Zuihō maru'. *Jap. Jour. Zool.*, 6 (4), pp. 621-636.
- : 石珊瑚に棲む短尾十脚類 *Hapalocarcinus* と *Cryptochirus* に就て (豫報) [On the coral-inhabiting crabs *Hapalocarcinus* and *Cryptochirus*. (Preliminary note).] 動物雜 [Zool. Mag.], 48 (4), pp. 234-235.
- : パラオ熱帯生物研究所の概観 [An outline of the Palao Tropical Biological Station.] 植物及動物 [Bot. & Zool.], 4 (2), pp. 411-450, (3), pp. 561-567.
- : 船底汚損生物の研究 (生物學と化學の協力) [Studies on the ship-fouling organisms (Co-operation between biology and chemistry).] *Ibid.*, 4 (5), pp. 905-917.
- : パラオの貝類相に就いて. I. 普通に見られる貝類とその棲息地 [Notes on the Molluscan fauna of Palao. I. Common shells and their habitats.] *Venus*, 6 (1), pp. 31-43.
- : パラオの貝類相に就いて. II. 外礁及び外礁湖に棲息する貝類 [Notes on the Molluscan fauna of Palao. II. Molluscs inhabiting the outer reef and lagoon.] *Ibid.*, 6 (4), pp. 208-221.
- KOMAI, Taku [駒井卓]: On another form of *Stephanoscyphus* found in the water of Japan. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 11 (3), pp. 175-183. [* 48]
- : The nervous system in some coelenterate types I. *Coeloplana*. *Ibid.* 11 (3), pp. 185-191. [* 49]
- : イラモ *Stephanoscyphus* に就いて [On the peculiar scyphopolyp, *Stephanoscyphus*.] 動物雜 [Zool. Mag.], 48 (8-10), pp. 535-534. (With English rés.)
- ONODA, Katsuzo [小野田勝造]: Notes on the development of some Japanese echinoids with special reference to the structure of the larval body. *Jap. Jour. Zool.*, 6 (4), pp. 637-654, pls. 10-14.
- : Preliminary notes on the experiments of hybridization of some echinoids. *Annot. Zool. Japon.*, 15 (3), pp. 325-333, pls. 19 & 20. [46b]
- : ガンガゼ *Diadema setosum* Gray 幼生の特異性 [Peculiarity of the larva of *Diadema setosum* Gray.] 動物雜 [Zool. Mag.], 48 (5), pp. 194-195.
- SAKAI, Tune: Studies on the crabs of Japan. I. Dromiacea. *Sci. Rep. Tokyo Bunrika Daigaku*, Sect. B, Suppl. No. 1, pp. 1-36, pls. 1-6.
- SHIINO, Sueo M.: Bopyrids from Tanabe Bay, III. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 11 (3), pp. 157-174. [* 47]

TOKUNAGA, Masaaki: Chironomidae from Japan (Diptera). VII. New species and a new variety of the genus *Chironomus* Meigen. *Philip. Jour. Sci.*, 60 (1), pp. 71-85, pls. 1-4. [* 51]

—: Chironomidae from Japan (Diptera), VIII. Marine or seashore *Spaniotoma*, with descriptions of the immature forms of *Spaniotoma nemalion* sp. nov. and *Tanytarsus boodlee* Tokunaga. *Ibid.*, 60 (3), pp. 303-321, pls. 1 & 2. [* 52]

TOKUNAGA, Masaaki & YOSHIMURA, Yoshihiro [徳永雅明・吉村義弘]: 海棲昆蟲 *Telmatogeton pacificus* Tokunaga の觸角の退化現象に就いて [On the degenerating phenomenon of tentacles of a marine midge, *Telmatogeton pacificus* Tokunaga.] 動物雜 [Zool. Mag.], 48 (4), pp. 222-224.

UCHIDA, Tohru [内田亨]: タテジマイソギンチャクに於ける品種の分布とその無性生殖の頻度とに及ぼす海流の影響 [Influence of the currents upon the distribution of race and frequency of asexual reproduction in the actinian, *Diadumene Luciae*.] *Ibid.*, 48 (8-10), pp. 895-906. (With English rés.)

YABE, Hisakatsu. SUGIYAMA, Teshio & EGUCHI, Motoki: Recent reef-building corals from Japan and the South Sea Islands under the Japanese mandate. *Sci. Rep. Tohoku Imp. Univ.*, 2nd Ser. (Geol.), Spec. Vol. 1, pp. 1-66, pl. 1-59.

YAMANOUCHI, Toshihiko [山内年彦]: 冬期水溫と魚類 [Seawater temperature and fishes in winter.] 動物雜 [Zool. Mag.], 48 (3), p. 142.

—: 魚類視覚の正確さ [Accuracy of vision in fishes.] *Ibid.*, 48 (4), p. 203.

1937 (昭和 12 年)

ABE, Noboru. EGUCHI, Motoki & HIRO, Fujio: Preliminary survey of the coral reef of Iwayama Bay, Palao. *Palao Trop. Biol. Sta. Studies*, 1 (1), pp. 17-35, pls. 1 & 2, 1 map.

BABA, Kikutaro: Opisthobranchia of Japan (II). *Jour. Dept. Agr. Kyushu Imp. Univ.*, 5 (7), pp. 289-344, pls. 1 & 2.

HAYASHI, Fumihiro: On the locomotion types of certain Japanese gastropods. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 12 (2), pp. 237-252.

HIRABAYASHI, Kiyoshi: Change of blastocoelic pH during gastrulation of the echinoid embryos. *Annot. Zool. Japon.*, 16 (3), pp. 205-209. [* 62]

HIRO, Fujio [弘富士夫]: A new barnacle, *Acasta echinata* n. sp. imbedded in the stalk of an alcyonarian from Southern Japan. (*Zool. Mag.*), 49 (2), pp. 70-71.

—: Studies on Cirripedian fauna of Japan. II. Cirripeds found in the vicinity of the Seto Marine Biological Laboratory. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 12 (3), pp. 385-478. [* 59]

- : Observations on the alcyonarian *Heteroxenia elizabetheae* K  lliker. *Annot. Zool. Japon.*, 16 (3), pp. 237-244.
- : Caprellids from Tanabe Bay. *Ibid.*, 16 (4), pp. 310-317, pl. 22. [* 63]
- : Cirripeds of the Palao Islands. *Palao Trop. Biol. Sta. Studies*, 1 (1), pp. 37-72, pl. 3.
- : Studies on the animals inhabiting reef corals. I. *Hapalocarcinus* and *Cryptochirus*. *Ibid.*, 1 (1), pp. 137-154, pls. 4-6.
- : Acrothoracica 日本に産す [Occurrence of the Acrothoracica in Japan,] 動物雑 [Zool. Mag.], 49 (3-4), pp. 135-156.
- : 完胸目 I (有柄蔓脚類) [Order Thoracica I (Pedunculate Cirripedia).] 日本動物分類 [Fauna Nipponica], 9 (1:5), vi+116 pp. 三省堂 [Sanseido Book Co.], Tokyo.
- : 紀州沿海の生物相 [Marine fauna and flora in the environs of Prov. Kii.] 科學畫報 [Sci. Graf.], 26 (8), pp. 13-16.
- MIYAKE, Sadayoshi: Porcellanids from Tanabe Bay. *Annot. Zool. Japon.*, 16 (13), pp. 210-216, pl. 12. [* 61]
- MORITA, Junichi: On the vital staining of the cytoplasmic granules. *Cyto'ogia*, Fujii Jubilee Vol., pp. 323-328. [* 58]
- OKADA, Y   K.: La stolonisation et les caract  res sexuels du stolon chez les Syllidiens Polych  tes (Etudes sur les Syllidiens III). *Jap. Jour. Zool.*, 7 (3), pp. 441-490, pl. 23.
- OKUDA, Shiro: Spioniform polychaetes from Japan. *Jour. Fac. Sci. Hokkaido Imp. Univ.*, Ser. 6, Zool., 5 (3), pp. 217-254. [* 56]
- : Notes on two unrecorded pelagic polychaetes from Japan. *Annot. Zool. Japon.*, 16 (1), pp. 75-77.
- SAKAI, T  ne: Studies on the crabs of Japan. II. Oxystomata. *Sci. Rep. Tokyo Bunrika Daigaku*, Sect. B, 3, Suppl. No. 2, pp. 67-192, pls. 10-19.
- SHIINO, S  eo M.: Bopyrids from Tanabe Bay, IV. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 12 (3), pp. 479-493. [* 60]
- : Two species of the gigantic mysidacean *Gnathophausia* found in Japan. *Annot. Zool. Japon.*, 16 (3), pp. 181-187.
- SUGIYAMA, Toshio [杉山敏郎]: 本邦沿岸産現棲造礁珊瑚に就きて [On the rescent reef-building corals along the coast of Japan.] 東北帝大地古邦文報告 [Contr. Inst. Geol. Paleont. Tohoku Imp. Univ. in Jap.], No. 26, pp. 1-60, pls. 1 & 2.
- TOKIOKA, Takasi: Notes on *Salpas* and *Doliolums* occurring on the Pacific coast of middle Japan. *Annot. Zool. Japon.*, 16 (3), pp. 219-232, pls. 13 & 14.
- TOXUNAGA, Masaaki [徳永雅明]: Sand flies (Ceratopogonidae, Diptera) from Japan. *Tenthredo*, 1 (3), pp. 233-338 pls. 24-29. [* 57]

- : 搖蚊科 (1) [Family Chironomidae (1).] 日本動物分類 [Fauna Nipponica], 10 (7:1), vi+110 pp. 三省堂 [Sanseido Book Co.], Tokyo.

1938 (昭和 13 年)

- BABA, Kikutaro: Opisthobranchia of Kii, middle Japan. *Jour. Dept. Agr. Kyusyu Imp. Univ.*, 6 (1), pp. 1-19. [* 68]
- HAYASHI, Ryoji [林良二]: Sea-stars in the vicinity of the Seto Marine Biological Laboratory. *Bull. Biogeogr. Soc. Japan.*, 8 (19), pp. 271-292, pls. 5-7. [* 73]
- : 日本南部諸島に於ける海星類 [Sea-stars in the southern islands of Japan.] 科學南洋 [South Seas Science], 1 (2), pp. 85-87.
- HIRO, Fujio [弘富土夫]: A new coral-inhabiting crab, *Pseudocryptochirus viridis* gen. et sp. nov. (Hapalocarcinidae, Brachyura). *Zool. Mag.*, 50 (3), pp. 149-151. [* 67]
- : *Cyamus e'ongatus* n. sp., a new whale lice from Japan. *Annot. Zool. Japon.*, 17 (1), pp. 71-77.
- : Notes on the animals found on *Macrocheira kaempferi* de Haan. I. Cirripeds, II. Molluscs. *Ibid.*, 17 (3-4), pp. 465-476. [* 72]
- : Studies on the animals inhabiting reef corals. II. Cirripeds of the genera, *Creusia* and *Pyrgoma*. *Palao Trop. Biol. Sta. Studies*, 1 (3), pp. 391-416, pl. 1.
- : *Balanus amphitrite* Darwin の日本産品種に就て [On the Japanese forms of *Balanus amphitrite* Darwin.] 動物雜 [Zool. Mag.], 50 (6), pp. 299-313. (With English rés.)
- : 無被ヒドロ蟲の一種 *Perigonimus repens* (Wright) の棲處及び分布に就て [On the habitat and distribution of athecate hydroid *Perigonimus repens* (Wright).] 植物及動物 [Bot. & Zool.], 6 (1), pp. 53-56; (2), pp. 405-408.
- : 數種フジツボの海水濃度の變化及日曝に對する抵抗性に就て [On the resistance of some littoral barnacles to altered salinity and sun-exposure.] *Ibid.*, 6 (10), pp. 1686-1690; (11), p. 1848-1854.
- : テフガヒに穿孔する貝に就て [Notes on *Lithophaga* and *Rocellaria* boring into shells of *Pinctada maxima* (Jameson).] *Venus*, 8 (2), pp. 85-88. (With English rés.)
- : 岩山灣の珊瑚礁と生物相 [Coral reef of Iwayama Bay, Palao and its inhabitants.] 科學南洋 [South Seas Science], 1 (1), pp. 13-19.
- : 南洋における研究事項二三 [Some problems worthy of research in the South Sea Islands.] *Ibid.*, 1 (1), pp. 25-27.
- KARO, Kojiro: Polyclads from Seto, middle Japan. *Jap. Jour. Zool.*, 7 (4), pp. 577-593, pls. 38 & 39. [* 69]
- KOMAI, Taku: Stomatopoda occurring in the vicinity of Kii Peninsula. *Annot. Zool. Japon.*, 17 (3-4), pp. 264-275. [* 70]

- KOSHIMIZU, Takuji: On the "Crimum Line" in the flora of Japan. *Bot. Mag.*, 52 (615), pp. 135-167. (With Japanese rés.)
- KUBO, Ituo: A new snapping shrimp belonging to the genus *Synalpheus*. *Annot. Zool. Japon.*, 17 (1), pp. 89-92. [* 66]
- MIYADI, Denzaburo [宮地傳三郎]: Ecological studies on marine relics and land-locked animals in inland waters of Nippon. *Philip. Jour. Sci.*, 65 (3), pp. 239-248. [* 74]
- : 大阪湾の底棲群聚の定量的研究 [Quantitative studies on the benthic communities of the Osaka-wan.] *海と空 [Sea & Sky]*, 18 (5), pp. 12-24.
- : 田邊湾の底棲群聚の豫察研究 [Preliminary reconnaissance on the benthic communities of the Tanabe-wan.] *日本水産學會誌 [Bull. Jap. Soc. Sci. Fish.]*, 7 (3), pp. 176-178. (With English rés.)
- : 沿岸水の汚染と底棲群聚 [The benthic community in relation to the pollution of coastal waters.] *水産研究誌 [Jour. Fish. Res.]*, 33 (9), pp. 414-417.
- MIYAKE, Sadoyoshi: Galatheids obtained from Ôshima, Prov. Kii. *Annot. Zool. Japon.*, 17 (1), pp. 37-42. [* 64]
- MORITA, Junichi [森田淳一]: *Spirulina* の構造及び運動に就いて [On the structure and movement of *Spirulina*.] *日本學術協會報告 [Rep. Jap. Soc. Adv. Sci.]*, 13 (3), pp. 585-589.
- OKADA, Yaichiro & MAWATARI, Shizuo: On the collection of Bryozoa along the coast of Wakayama-ken, the middle part of Honsyu, Japan. *Annot. Zool. Japon.*, 17 (3-4), pp. 445-463, pl. 24. [* 71]
- ONODA, Katsuzo (小野田勝造): Notes on the development of some Japanese echinoids, with special reference to the structure of the larval body. Report III. *Jap. Jour. Zool.*, 8 (1), pp. 1-13. [* 75]
- : 海膽類に於ける交雑實驗 [Hybridization experiments in some echinoids.] *遺傳雜 [Jap. Jour. Genetics]*, 13 (6), pp. 306-320. (With English rés.) (11)
- SAKAI, Tune: Brachyura obtained from Ôshima, Prov. Kii. *Annot. Zool. Japon.*, 17 (1), pp. 53-57. [* 65]
- : On three systematically interesting crabs from Japan one of which is new to science. *Ibid.*, 17 (3-4), pp. 301-307.
- : Studies on the crabs of Japan. III. Brachygnatha, Oxyrhyncha. Publ. by the author. pp. 193-364, pls. 20-41.
- TOKIOKA, Takasi [時岡隆]: サルパ (太利亞) 目 [Order Thaliacea.] *日本動物分類 [Fauna Nipponica]*, 14 (2:1), iii+100 pp. 三省堂 [Sanseido Book Co.], Tokyo.
- YASUDA, Minoru & KAGAMI, Hiroshi: On the ova of sea urchin as the experimental materials for biological studies of X-rays. *Jap. Jour. Obstetr.*, 21 (1), pp. 102-106; (5), pp. 723-730, (With Japanese rés.)

1939 (昭和 14 年)

- HATAI, Kotera M.: On some recent Brachiopoda from Seto, Prov. Kii. *Rec. Ocean. Wks. in Japan*, 10 (2), pp. 100-111. [^{*} 76]
- HAYASHI, Ryoji [林良二]: 日本南部諸島に於ける海星類 (補遺) [Sea-stars in the southern islands of Japan. (Supplementary note)]. 科學南洋 [South Sea Science], 2 (1), p. 49.
- HIRO, Fujio [弘富士夫]: Some barnacles from the Ogasawara Islands. *Annot. Zool. Japon.*, 18 (1), pp. 49-57.
- : Notes on the animals found on *Macrocheira kaempferi* de Haan. III. Hydroids. *Ibid.*, 18 (3), pp. 167-176. [^{*} 77]
- : Studies on the Cirripedian fauna of Japan. III. Supplementary notes on the cirripeds found in the vicinity of Seto. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 15 (2), pp. 237-244. [82]
- : Studies on the Cirripedian fauna of Japan. IV. Cirripeds of Formosa (Taiwan), with some geographical and ecological remarks on the littoral forms. *Ibid.*, 15 (2), pp. 245-284. [81]
- : Studies of the Cirripedian fauna of Japan. V. Cirripeds of the northern part of Honsyû. *Sci. Rep. Tohoku Imp. Univ.*, 4th Ser. (Biol.), 14 (2-3), pp. 201-218.
- : On the barnacle communities at the Madarai pier in Kororu Island. *Palao Trop. Biol. Sta. Studies*, 1 (4), pp. 585-595.
- : 台灣に於ける沿岸性蔓脚類の分布 [Distribution of littoral barnacles in Formosa.] 動物雜 [Zool. Mag.], 51 (2), p. 128.
- : 台灣南部の珊瑚礁と沿岸動物相管見 [A glimpse on the coral reef and coastal fauna of southern Formosa.] 植物及動物 [Bot. & Zool.], 7 (5), p. 1057-1062.
- : 石灰岩島の周邊に形成せられる凹陷帶に就て [On the formation of the undercutting of raised coral cliffs] 科學南洋 [South Seas Science], 1 (3), pp. 138-146.
- KOMAI, Taku [駒井卓]: 京都帝國大學理學部瀬戸臨海實驗所 (附 水族館) [Seto Marine Biological Laboratory, College of Science, Kyoto Imperial University. (Appendix: Aquarium)] 24 pp., 2 maps, 8 pls.
- KOMAI, Taku & TOKUOKA, Yasuhiro: Further observations on the strobilation of *Stephanoscyphus*. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 15 (2), pp. 127-133. [83]
- MIYADI, Denzaburo [宮地傳三郎]: 大阪灣の底棲群聚 [Benthic communities of the Osaka-wan.] 動物雜 [Zool. Mag.], 51 (2), pp. 91-92.
- OKADA, Yo K. [岡田要]: フジツボに就て [On barnacles.] 海軍技術雜報 [Misc. Rep. Naval Inst. Tech. Res.], No. 237, pp. 31-34.
- SAKAI, Tune: Studies on the crabs of Japan. IV. Brachygnatha, Brachyrhyncha. Publ. by the author. pp. 365-741, pls. 42-111.

- SHINO, Sueo M.: Bopyrids from Tanabe Bay. *V. Annot. Zool. Japon.*, 18, (1), pp. 11-16.
- TAKEDA, Nobuyuki [武田信之]: 海産糠胸類 *Tigriopus japonicus* Mori の雌雄性に及ぼす外界の影響. I. 塩素酸加里の作用に就て (豫報) [Sex determination and sex differentiation in the marine copepod, *Tigriopus japonicus* Mori. I. The influence of potassium chlorate. (a preliminary note.)] 動物雑 [Zool. Mag.], 51 (1), 1-13. (With English rés.)
- TOKIOKA, Takasi [時岡隆]: A new brackish water chaetognath. *Annot. Zool. Japon.*, 18 (4), pp. 277-281, pl. 14. [79]
- : Chaetognaths collected chiefly from the bays of Sagami and Suruga, with some notes on the shape and structure of the seminal vesicle. *Rec. Ocean. Wks. in Japan*, 10 (2), pp. 123-150, pls. 1-4.
- : Three new chaetognaths from Japanese waters. *Mem. Imp. Mar. Observ. (Kobe)*, 7 (1), pp. 129-140.
- : 大阪湾に於ける矢蟲類及び浮游性被囊類の觀察 [Observations on the chaetognaths and pelagic tunicates in the Osaka Bay.] 海と空 [Sea and Sky], 19 (6), pp. 152-160.
- TOKUOKA, Yasuhiro [徳岡泰廣]: フジツボの形態的生態的及生理的研究に就て [On the morphological, ecological and physiological studies on barnacles.] 海軍技術雑報 [Misc. Rep. Naval Inst. Tech. Res.], No. 237, pp. 23-30.
- YAMAGUTI, Satyu: Parasitic copepods from fishes of Japan. Part 5. Caligoida, III. *Volumen Jubilare pro Prof. Sadao. Yoshida*, 2, pp. 443-487, pls. 14-33.
- YOSII, Narao & TOKIOKA, Takasi: Notes on Japanese *Spadella* (Chaetognatha). *Annot. Zool. Japon.*, 18 (4), pp. 267-275, pl. 13. [89]

1940 (昭和 15 年)

- HAYASHI, Ryoji: Contributions to the classification of the sea-stars of Japan. I, Spinulosa. *Jour. Fac. Sci. Hokkaido Imp. Univ.*, Ser. 6, Zool., 7 (3), pp. 107-204, pls. 7-13.
- HONJO, Ichijiro: Beiträge zur Nervenmuskelpysiologie der koloniebildenden Tiere. I. Die Peristaltik von *Cavernularia*. *Annot. Zool. Japon.*, 19 (4), pp. 301-308. [92]
- KOMAI, Taku: *Gonodactylus furcicaudatus* Miers, a remarkable stomatopod. *Ibid.*, 19 (1), pp. 47-50. [85]
- KOMAI, Taku & TOKIOKA, Takasi: *Kiyohimea aurita* n. gen., n. sp., type of a new family of a lobate Ctenophora. *Ibid.*, 19 (1), pp. 43-46. [*86]
- MIYADI, Denzaburo [宮地傳三郎]: Marine benthic communities of the Osaka-wan. *Jour. Ocean.*, 12 (2), pp. 1-15. [84]

- : Marine benthic communities of the Tanabe-wan. *Annot. Zool. Japon.*, 19 (2), pp. 136-148. [88]
- : 田邊灣軟底部の底棲動物 [Benthic animals of the soft bottom of the Tanabe-wan.] 動物雜 [Zool. Mag.], 52 (2), pp. 55-56.
- : 田邊灣軟底部の群聚 [Soft bottom communities of the Tanabe-wan] 植物及動物 [Bot. & Zool.], 8 (2), pp. 377-383.
- : 大阪灣の底棲群聚の定量的研究 (第2報) [Quantitative studies on the benthic communities of the Osaka-wan, II.] 日本學術協會報告 [Rep. Jap. Soc. Adv. Sci.], 15 (3), pp. 332-334.
- MIYASHITA, Yoshinobu: On an entoniscid with abbreviated development, *Entoniscoides okadaï*, n. g., n. sp. *Annot. Zool. Japon.*, 19 (2), pp. 146-157, pl. 7. [89]
- NOZAWA, Kanefumi: Problem of the diurnal rhythm in the cell division of the dinoflagellate, *Oxyrrhis marina*. *Annot. Zool. Japon.*, 19 (3), pp. 170-174. [90]
- : Studies on the quantitative relation between the nuclei and the cytoplasm in *Actinosphaerium eichhorni*. I. *Jap. Jour. Zool.*, 9 (1), pp. 139-152. [91]
- TOKIOKA, Takasi [時岡隆]: Some additional notes on the Appendicularian fauna. *Rec. Ocean. Wks. in Japan*, 11 (1), pp. 1-26. [* 78]
- : The chaetognaths fauna of the waters of western Japan. *Ibid.*, 12 (1), pp. 1-22. [87]
- : A small collection of chaetognaths from the coast of New South Wales. *Rec. Austr. Mus.*, 20 (6), pp. 367-379.
- : 毛顎動物門 [Phylum Chaetognatha.] 日本動物分類 [Fauna Nipponica], 5 (2), 129 pp. 三省堂 [Sanseido Book Co.], Tokyo.
- YAMANOUCHI, Toshihiko [山内年彦]: 魚類の視力(視精度)に就て(續報) [On the visual power of fishes. (Supplementary note.)] 動物雜 [Zool. Mag.], 52 (2), p. 75.

1941 (昭和 16 年)

- INOH, Syumpei [猪野俊平]: マクサの孢子發生に就て [On the germination of spores in *Gelidium Amansii* Lmx.] 植物及動物 [Bot. & Zool.], 9 (5), pp. 877-880.
- KOMAI, Taku [駒井卓]: 日本近海の名寶 [Noticeable animals in the Japanese waters.] 改造 [Kaizo], 23 (15), pp. 171-175.
- : A new remarkable sessile ctenophore. *Proc. Imp. Acad.*, 17 (6), pp. 216-220. [* 96]
- KURODA, Tokubei [黒田徳米]: 貝類談話室 [Miscellaneous notes on shells.] *Venus*, 11 (1), pp. 32-37.

- MASUI, Tetuo [増井哲夫]: 波浮港に於ける硫化物の堆積と底棲群衆 [The benthic communities of the Habu-ko with special reference to the sulphides in the sediments.] 水産雑 [Jour. Fish.], No. 49, pp. 66-71. (With English rés.) (4)
- MIYADI, Denzaburo: Indentation individuality in the Tanabe-wan. *Mem. Imp. Mar. Observ. (Kobe)*, 7 (4), pp. 471-482. [93]
- : Marine benthic communities of the Beppu-wan. *Ibid.*, 7 (4), pp. 483-502. [94]
- : Marine benthic communities of the Ise-wan and the Mikawa-wan. *Ibid.*, 7 (4), pp. 503-524. [95]
- : Ecological survey of the benthos of the Ago-wan. *Annot. Zool. Japon.*, 20 (3), pp. 169-180. [99]
- MIYASHITA, Yoshinobu: On the occurrence of a new *Hydrichthys* in the Pacific coast of Japan. *Ibid.*, 20 (3), pp. 151-153. [100]
- NOZAWA, Kanefumi [野澤兼文]: A new primitive hypotrichous ciliate, *Kiitricha marina* n. g., n. sp. *Ibid.*, 20 (1), pp. 24-26. [97]
- : Studies on the quantitative relation between the nuclei and the cytoplasm in *Actinosphaerium eichhorni*. Part II and III. *Cytologia*, 12 (1), pp. 112-134. [98]
- : 太陽蟲 *Actinosphaerium eichhorni* (Ehrenberg) の核細胞質間の定量的關係に就て [On the quantitative relation between the nuclei and the cytoplasm in *Actinosphaerium eichhorni* (Ehrenberg).] 動物雑 [Zool. Mag.], 53 (2), p. 122.
- : 太陽蟲 *Actinosphaerium eichhorni* に於ける核細胞質間の定量的關係. 第4報 原蟲及び他の生物に於ける所謂‘核細胞面積’と‘核表面積比’に就て [Studies on the quantitative relation between the nuclei and the cytoplasm in *Actinosphaerium eichhorni*. Part IV, On the so-called nucleoplasmic ratio and nucleo-surface ratio in some Protozoa and other organisms.] *Ibid.*, 53 (10), pp. 475-488. (With English rés.) (3)
- OKADA, Yô K., NAGATA, Y., HIRABAYASHI, K. & TOKUOKA, Y. [岡田要・永田義夫 平沢清・徳岡泰廣]: 船底附着生物に關する基礎的研究 (東京及京都帝大擔當研究綜合報告) [Fundamental studies on the ship-bottom fouling organisms.] 海軍技研報告 [Rep. Naval Inst. Tech. Res.], No. 01134, pp. 1-90.
- TAKEDA, Nobuyuki [武田信之]: 海産橈脚類 *Tigriopus japonicus* Mori の雌雄性に及ぼす外界の影響. (I) 塩素酸加里及び塩化加里の影響 [Sex determination and sex differentiation in the marine copepod, *Tigriopus japonicus* Mori. (I) The influence of potassium chlorate and potassium chloride.] 動物雑 [Zool. Mag.], 53 (1), pp. 22-31. (With English rés.) (1)
- : 海産橈脚類 *Tigriopus japonicus* Mori の雌雄性に及ぼす外界の影響. (II) クロレトン, 抱水クロラルール及びチヨードチロジンの影響 [Sex determination and sex

differentiation in the marine copepod, *Tigriopus japonicus* Mori. (II) The influences of chloreton, chloral hydrate and diiodtyrosin.] *Ibid.*, 53 (3), pp. 158-170. (With English rés.) (2)

YABE, Hisakatsu & SUGIYAMA, Toshio: Recent reef-building corals from Japan and the South Sea Islands under the Japanese mandate, II. *Sci. Rep. Tohoku Imp. Univ.*, 2nd Ser. (Geol.), Spec. Vol., No. 2, pp. 67-91, pls. 60-104.

1942 (昭和 17 年)

HABE, Tadashige [波部忠重]: アハホホヅキはバイの卵嚢ではない. ["Awahoozuki" is not the egg-capsule of *Babylonia japonica* (Reeve).] *Venus*, 12 (1-2), pp. 102-103.

———: 海の貝類 [Marine shells.] 岩田正俊編: “海の生物” [M. IWATA's “Marine organisms”], pp. 108-126. 文祥堂 [Bunsyodo Book Co.], Osaka.

INOH, Syumpei [窪野俊平]: 紅藻類の孢子發生に就て [On the germination of spores in the Rhodophyceae.] 日本學術協會報告 [*Rep. Jap. Soc. Adv. Sci.*], 16 (4), pp. 609-613.

KAMOHARA, Toshiji [蒲原稔治]: Twelve unrecorded species of fishes from Kii Peninsula. *Annot. Zool. Japon.*, 21 (3), pp. 163-168. [113]

———: 紀州及び土佐の珍稀魚類 [Rare fishes from the seas of Kii and Tosa.] 動物雜 [*Zool. Mag.*], 54 (1), pp. 2-28.

KOMAI, Taku [駒井卓]: The nematocysts in the ctenophore *Euchlora rubra*. *Proc. Imp. Acad.*, 18 (5), pp. 255-256. [101]

———: The nervous system in some coelenterate types. 2, Ephyra and Scyphura. *Annot. Zool. Japon.*, 21 (1), pp. 25-29. [* 107]

———: The structure and development of the sessile ctenophore *Lyrocteis imperatoris* Komai. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 17 (1), pp. 1-36, pls. 1-3. [108]

———: 扁櫛類に就て [On the Platyctenia.] 広島博物學會誌 [*Jour. Nat. Hist. Soc. Hiroshima*], No. 10, pp. 1-4.

———: 琴水母と其近似種 [*Lyrocteis imperatoris* Komai and its allied species.] 植物及動物 [*Bot. & Zool.*], 10 (1), pp. 15-18; (2), pp. 109-112; (3), pp. 209-216.

KOMAI, Taku and TOKIOKA, Takasi: Three remarkable ctenophores from the Japanese seas. *Annot. Zool. Japon.*, 21 (3), pp. 144-151. [111]

KURODA, Tokubei [黒田徳米]: 學名を失ひたる本邦産骨貝類 2種 [Two Japanese Muri-ces whose names have been preoccupied.] *Venus*, 12 (1-2), pp. 80-81.

———: 相似寶貝類の類似 [Classification of some closely allied species of Japanese Cypraeidae.] *Ibid.*, 12 (1-2), pp. 81-93.

- MIYADI, Denzaburo [宮地傳三郎]: 京都帝大瀬戸臨海實驗所 [Seto Marine Biological Laboratory of the Kyoto Imperial University.] 海洋の科學 [Science of the Sea,] 2 (5), pp. 370-377.
- MIYADI, Denzaburo & MASUI, Tetuo [宮地傳三郎・増井哲夫]: 鹿児島灣及び山川港の底棲群聚に就いて [On the benthic communities of the Kagoshima-wan and the Yamakawa-kō.] 海洋時報 [Jour. Ocean.], 13 (3), pp. 751-762. (5)
- & ———: 的矢灣及び五ヶ所灣の底棲群聚の比較研究 [Comparative studies of the benthic communities of the Matoya-wan and the Gokasyo-wan.] 日本水産學會誌 [Bull. Jap. Soc. Fish.], 11 (3), pp. 111-127. (12)
- MIYADI, D., MASUI, T. & MATSUNAGA, T. [宮地傳三郎・増井哲夫・松永保]: 福岡灣の底棲群聚の定量的研究 [Quantitative studies on the benthic communities of the Hukuoka-wan.] 海と空 [Sea & Sky], 22 (7), pp. 22-251. (8)
- NOZAWA, Kanefumi: Systematic studies of the plankton organisms occurring in Iwayama Bay, Palao. V. Two planktonic suctorians from Palao. *Palao Trop. Biol. Sta. Studies*, 2 (3), pp. 581-584, pl. 15. [105]
- OHUYE, Toshio: On the blood corpuscles and the blood formation in *Phoronis* (The 13th report of invertebrate hematology). *Sci. Rep. Tohoku Imp. Univ.*, 4th Ser. (Biol.), 17 (2), pp. 167-185.
- SHIINO, Suetō M.: On the parasitic isopods of the family Entoniscidae, especially those found in the vicinity of Seto. *Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, 17 (1), pp. 37-76. [109]
- : Studies on the embryology of *Squilla oratoria* de Haan. *Ibid.*, 17 (1), pp. 77-174, pls. 4-14. [*110]
- TOKIOKA, Takasi [時岡隆]: Ascidians found on the mangrove trees in Iwayama Bay, Palao. *Palao Trop. Biol. Sta. Studies*, 2 (3), pp. 497-505, pl. 4. [102]
- : Systematic studies of the plankton organisms occurring in Iwayama Bay, Palao. I. Introductory notes, with some references to the surface water temperature and the settling volume of planktons in the bay. *Ibid.*, 2 (3), pp. 507-519. [103]
- : Systematic studies of the plankton organisms occurring in Iwayama Bay, Palao. III. Chaetognaths from the Bay and adjacent waters. *Ibid.*, 2 (3), pp. 527-548, pls. 5-7. [104]
- : Systematic studies of the plankton organisms occurring in Iwayama Bay, Palao. VII. A preliminary report on the Appendicularian fauna of the Bay and the adjacent waters. *Ibid.*, 2 (3), pp. 613-616. [106]
- : A gigantic *Bipinnaria* (*B. setoensis*, n. sp.) from Seto. *Annot. Zool. Japon.*, 21 (3), pp. 152-154. [112]

- : パラオ礁湖内数地點のプランクトン比較 [Comparison of planktons hauled at several stations in the lagoon of the Palao Islands.] 科學南洋 [South Seas Science], 4 (3), pp. 177-191. (6)
- : 岩山灣に於ける表面水温の分布 [Distribution of surface water temperature in Iwayama Bay.] *Ibid.*, 4 (3), pp. 242-243. (7)
- : 岩山灣及びパラオ諸島周辺海區に於けるプランクトン量 [Settling volumes of planktons in Iwayama Bay and adjacent waters of the Palao Islands.] *Ibid.*, 5 (1), pp. 44-55. (10)
- UTINOMI, Huzio (formerly HIRO, Fujio) [内海(=弘)富士夫]: 岩山灣岩礁帯に於ける穿孔貝類及び蔓脚類の分布 [Distribution of boring molluscs and cirripeds in the rocky zone of Iwayama Bay.] *Ibid.*, 5 (1), pp. 1-14, pl. 1. (9)
- : 石灰物質に穿孔する藻類 [Algae boring into calcareous substances.] *Ibid.*, 5 (1), pp. 123-128.
- : 南方國の臨海實驗所と其の過去の業績 [Marine biological laboratories in the southern region and their work in the past.] *Ibid.*, 5 (1), pp. 151-155.
- : 海の生物の適應 [Adaptation of marine organisms.] 岩田正俊編: “海の生物” [M. IWATA'S “Marine organisms”], pp. 127-149. 文祥堂 [Bunsyodo Book Co.], Osaka.
- YABE, Hisakatsu & EGUCHI, Motoki: Fossil and recent *Flabellum* from Japan. *Sci. Rep. Tohoku Imp. Univ*, 2nd Ser. (Geol.), 22 (2), pp. 87-103, pls. 5-8.
- & ——— : Fossil and recent simple corals from Japan. *Ibid.*, 22 (2), pp. 105-178, pls. 9-12.

1943 (昭和 18 年)

- HABE, Tadashige [波部忠重]: 薩摩山川港の底棲群聚の再調査, 特に深部還元層の群聚に就いて [The second survey of the benthic communities of the Yamakawa-kō, with special reference to the deep reduction layer.] 日本海洋學會誌 [Jour. Ocean. Soc. Japan], 2 (4), pp. 17-25. (14)
- : イナザハハベガヒ *Habea inazawai* Kuroda, 特にその發生に就いて [Observations on *Habea inazawai* Kuroda, with special reference to its development.] 貝類雜 [Jap. Jour. Malac. (formerly Venus)], 13 (1-4), pp. 65-67. (With English rés.) (21a)
- : 日本産海産腹足類の歯舌に就いて (1) [On the radulae of Japanese marine gastropods (1).] *Ibid.*, 13 (1-4), pp. 68-76, pls. 3 & 4. (21b)
- : イシカハシタダミ紀州に産す [Occurrence of *Caledoniella montrouzieri* Souverbie in Prov. Kii.] *Ibid.*, 13 (1-4), pp. 130-131.
- : 日本産カラマツガヒ科 [Japanese Siphonariidae.] *Ibid.*, 13 (1-4), pp. 131-132,

- : キヌタレガヒ [*Solenomya* (= *Solemya*) *pusilla* Gould.] *Ibid.*, 13 (1-4), pp. 133-132.
- HAYASHI, Ryoji: Contributions to the classification of the sea stars of Japan. II. Forcipulata, with the note on the relationships between the skeletal structure respiratory organs of the sea stars. *Jour. Fac. Sci. Hokkaido Imp. Univ.*, Ser. 6, Zool., 8 (3), pp. 138-281, pls. 12-22.
- INOH, Syumpei [猪野俊平]: スラクサの胞子發生に就て [On the germination of spores in *Halymenia Agardhii* de Toni.] 植物及動物 [*Bot. & Zool.*], 11 (11), pp. 863-867. (With English rés.).
- KOMAI, Taku [駒井卓]: 刺胞を有する櫛水母 [*Euchlora rubra*, a ctenophore provided with nematocysters.] 動物雑 [*Zool. Mag.*], 55 (2), pp. 79-80.
- : 或種腔腸動物に於ける個蟲又は器官の排列 [Arrangement of zooids or organs in some coelenterates.] *Ibid.*, 55 (11), pp. 353-354.
- : 中生動物 [Mesozoa.] 大島廣・岡田彌一郎編: “系統動物學” [H. OHSHIMA & Y. OKADA's “Systematic zoology”] I, pp. 295-302. 養賢堂 [Yokendo Book Co.], Tokyo.
- KURODA, Tokubei [黒田徳米]: 日本新貝類 (4) [New Japanese shells (4).] 貝類雜 [*Jap. Jour. Malac.*], 13 (1-4). (With English rés.) (19a)
- : 中國地方の陸産貝類 (1). ムシオヒガヒの新亜屬新種 [New land shells from Tyûgoku district (1). A new species belonging to a new subgenus of the genus *Chamalycaeus*.] *Ibid.*, 13 (1-4), pp. 7-11. (With English rés.) (19b)
- : 新屬新種巻貝イナザハハベガヒに就いて [On a new gastropod genus *Habea*.] *Ibid.*, 13 (1-4), pp. 11-14. (With English rés.) (19c)
- : 二枚貝新屬アケビガヒ [*Akebiconcha*, a new pelecypod genus.] *Ibid.*, 13 (1-4), pp. 14-18. (With English rés.) (19d)
- MASUI, Tetsuo [増井哲夫]: 東京灣の底棲群聚に就て [On the benthic communities of the Tokyo-wan.] 日本海洋学会誌 [*Jour. Ocean. Soc. Japan*], 3 (2), pp. 130-141. (22)
- MIYADI, Denzaburo & MASUI, Tetuo [宮地傳三郎・増井哲夫]: 七尾灣の底棲群聚の研究 [Studies on the benthic communities of the Nanao-wan.] *Ibid.*, 2 (1), pp. 1-21. (13)
- MIYADI, D., MASUI, T., YAMANE, K., KATO, S. & NOMURA, S. [宮地傳三郎・増井哲夫・山根謹爾・加藤鈴郎・野村茂夫]: 波浮港に於ける海水の停滞と循環並にその底棲動物 [Circulation and stagnation of sea water in the Habu-kō and benthic animals there.] 神戸海洋気象台集報 [*Bull. Kobe M. r. Observ.*], No. 149, pp. 46-52.
- MIYAKE, Sadayoshi: Studies on the crab shaped Anomura of Nippon and adjacent waters. *Jour. Dept. Agr. Kyusyu Imp. Univ.*, 7 (3), pp. 49-158.
- MORI, Syuiti [森主一]: イソギンチャク類 3 種の日週期活動 [Daily rhythmic activity

- of 3 species of actinians.] 動物雑 [Zool. Mag.], 55 (1), pp. 1-7, pl. 1. (16)
- : ウミシヤボテン *Cavernularia obesa* Valenciennes の日週期活動 I. 自然状態に於ける観察 [Daily rhythmic activity of the sea-pen *Cavernularia obesa* Valenciennes. I. Observations in its natural habitat.] *Ibid.*, 55 (8), pp. 285-291. (17)
- : ウミシヤボテン *Cavernularia obesa* Valenciennes の日週期活動 II. 恒暗, 恒明状態に於ける活動 [Daily rhythmic activity of the sea-pen *Cavernularia obesa* Valenciennes. II. Activities under constant darkness and brightness.] *Ibid.*, 55 (7), pp. 247-253, pl. 1. (18)
- MURAKAMI, Shiro: Ophiurans from some gulfs and bays of Nippon. *Jour. Dept. Kyusyu Imp. Univ.*, 7 (6), pp. 223-234.
- NOZAWA, Kanefumi [野澤兼文]: Studies on the nucleo-plasmic ratio. II. Absolute magnitude of the ratio in *Noctiluca*. *Cytologia*, 13 (1), pp. 120-125.
- : 細胞の比重測定に用ひる Stokes の式とその變法 [Stokes' formula used for the measurement of specific gravity and its modification.] 科学 [Science], 13 (5), pp. 172-173.
- : 核細胞質間の定量的關係—核細胞質比の生理學的考察 [Quantitative relation between nuclei and protoplasm—a physiological consideration on the nucleo-plasmic ratio.] 動物雑 [Zool. Mag.], 55 (5), pp. 191-202.
- : 夜光蟲の比重とその周圍海水への適應 [Specific gravity and its adaptation to environmental sea water in *Noctiluca*.] *Ibid.*, 55 (9-10), pp. 305-314. (20)
- ONOGA, Katsuzo: Note on the development of some Japanese echinoids. Report IV. Hybridization experiments with some Japanese echinoids. *Jap. Jour. Zool.*, 10 (3), pp. 407-426. [* 117]
- SATO, Iwane [佐藤磐根]: 海産巻貝の再生域に於ける血球細胞の行動 [Behaviour of blood-corpuscles of a marine gastropod *Strombus luhuanus* in the regenerating field.] 科学 [Science], 13 (4), pp. 122-126. (*15)
- SHINO, Sueo M. [椎野季雄]: Rhizocephala of Japan. *Jour. Sigenkagaku Kenkyusyo*, 1 (1), pp. 1-36.
- : 寄生性甲殻類と其宿主甲殻類との種的關係 [Specific relation between parasitic crustaceans and their host crustaceans.] 動物雑 [Zool. Mag.], 55 (2), p. 81.
- TAKAMATSU, Masahiko: The species of *Sphacelaria* from Japan, I. *Jour. Sigenkagaku Kenkyusyo*, 1 (2), pp. 153-187, pls. 8-13.
- TANITA, Senji: Studies on the Calcarea of Japan. *Sci. Rep. Tohoku Imp. Univ.*, 4th Ser. (Biol.), 17 (4), pp. 353-490, pls. 11-18
- UTINOMI, Huzio [内海富士夫]: The larval stages of *Creusia*, the barnacle inhabiting reef corals. *Annot. Zool. Japon.*, 22 (1), pp. 15-22. [114]
- : Caprellids obtained in Onagawa Bay, northern Japan. *Sci. Rep. Tohoku*

- Imp. Univ.*, 4th Ser. (Biol.), 17 (3), pp. 271-279. (115)
- : Report of the biological survey of Mutsu Bay. 37. Caprellids from Asamusi. *Ibid.*, 17 (3), pp. 281-287. (116)
- : The fauna of Akkeshi Bay XIII. Caprellidea. *Jour. Fac. Sci. Hokkaido Imp. Univ.*, Ser. 6, Zool., 8 (3), pp. 283-300.
- : 沿岸性蔓脚類の成長型と附着方向 [Growth form and orientation of littoral cirripeds.] 動物雑誌 [Zool. Mag.], 56 (2), pp. 77-78.
- : ウミガメ——産卵・習性・成長 [Sea-turtle; its egg-lying, habit and growth.] 海洋の科学 [Science of the Sea], 3 (11), pp. 526-532.
- : 珊瑚礁の生態 [The ecology of coral reefs.] 大島正満編: “南海の驚威” [M. OSHIMA'S “Wonder of south seas”, p. 222-269. 大阪屋號書店 [Osakayago Book Co.], Tokyo.
- : 論文を通して見た南洋群島の生物學研究史 [A historical consideration of biological researches on the South Sea Islands]. 科学 [Science], 13 (9), pp. 327-329. (24)
- : 海のプランクトン [Marine plankton.] 岩田正俊編: “顯微鏡で見る生物” [M. IWATA'S “Living organisms under microscope”, p. 1-27. 文祥堂 [Bunsyodo Book Co.], Osaka.
- YAMANOUTI, Toshihiko (山内年彦): 黒ナマコ (*Holothuria vagabunda*) の体内毒素の分布に就て [On the distribution of internal poisonous elements in *Holothuria vagabunda*.] 動物雑誌 [Zool. Mag.], 55 (2), pp. 87-88.

1944 (昭和 19 年)

- HABE, Tadashige (波部忠重): 日本産ウノアシ科 Lottiidae (=Acmaeidae) に就いて [On the Lottiidae (=Acmaeidae) in Japan.] 貝類雑誌 [Jap. Jour. Malac.], 13 (5-8), pp. 171-187. (23a)
- : 日本産海産腹足類の卵及び幼生の研究 (1) [Studies on the eggs and larvae of Japanese marine gastropods (1).] *Ibid.*, 13 (5-8), pp. 187-194 (23b)
- : 海産貝類の卵嚢に就いて (日本産海産腹足類の卵及び幼生の研究 2.) [On the egg-capsules of marine gastropods (Studies on the eggs and larvae of Japanese marine gastropods (2)).] *Ibid.*, 13 (5-8), pp. 194-201. (23c)
- : 紀州産ベツカフタマガヒ属 *Lamellaria* の新種 [Two new species of the genus *Lamellaria* from Kii.] *Ibid.*, 13 (5-8), pp. 201-203. (23d)
- : ベツカフタマガヒ属浮游幼生 *Echinospira* の2新形 [Two new forms of *Echinospira*, a free-swimming larva of the gastropod genus *Lamellaria*.] *Ibid.*, 13 (5-8), pp. 203-206. (23e)
- : 日本産の *Mucronalia* 属 [The gastropod genus commensal with the echinoderms, *Mucronalia* from Japan.] *Ibid.*, 13 (5-8), pp. 311-313.

- : 日本及び南方産の木船喰害蟲類に就いて [On the marine wood borers from Japan and southern seas.] 色材協會誌 [*Sikizai-Kyokai Si.*], 18 (5), pp. 117-120.
- : 日本産として新に加へられたフナクヒムシ類2種 [Two species of shipworms, newly added to the Japanese fauna.] 木船蟲害防除研究者連絡通信 [*Marine Borers Researchers Information*], No. 2, pp. 1-3.
- ; 船喰蟲類の種の檢索表 [Key to the species of shipworms found in Japan.] *Ibid.*, No. 8, pp. 1-10, 1 pl. (Mimeographed)
- : 若狭小湊灣の船喰蟲 [Shipworms from Obama Bay, Prov. Wakasa.] *Ibid.*, No. 9, pp. 1-6. (Mimeographed)
- : 船喰蟲類の種の檢索表の追補と訂正 [Additions and corrections to the key to the species of shipworms found in Japan.] *Ibid.*, No. 9, pp. 6-8. (Mimeographed)
- : 浦原稔治博士の採集にかかる九州地方の船喰蟲 [Shipworms collected by Dr. T. Kamohara in Kyusyu.] *Ibid.*, No. 9, pp. 8-11. (Mimeographed)
- : 漂着せる椰子殻より採集された船喰蟲3種に就いて [On three species of shipworms collected from a palm nut cast ashore.] *Ibid.*, No. 9, pp. 11-17. (Mimeographed)
- HONJO, Ichijiro [本城市次郎]: ウミシヤボテンの神経生理的遺 [Additions to the nerve physiology of the sea-pen, *Cavernularia obesa* Val.] 京都大學生理生態學研究業績 [*Rep. on Physiol. & Ecol., Kyoto Imp. Univ.*], No. 9, pp. 1-13. (Mimeographed)
- KOMAI, Taku [駒井卓]: 南方に於ける木船蟲害防除法 (某専門家の視察報告に依る) [Methods for the protection of wooden ships against marine borers in the Southern region. (after a report of inspection by a specialist.)] 木船蟲害防除研究者連絡通信 [*Marine Borers Researchers Information.*], No. 2, pp. 3-4.
- KOMAI Taku & YAMAZI, Isamu: The asexual reproduction of the Hydromedusae *Gastroblasta chenghanensis*. *Annot. Zool. Japon.*, 22 (3), pp. 105-108. [* 118]
- KURODA, Tokubei [黒田徳米]: 日本産新貝類 (5) [New Japanese shells (5).] 貝類雜 [Jap. Jour. Malac.], 13 (5-8), pp. 237-239, pl. 7 (*25)
- : 田邊灣神島産陸貝 [Land shells from Kasima, an inlet in Tanabe Bay.] *Ibid.*, 13 (5-8), pp. 313-316.
- : 邦産アサガホガヒ科の新加入種 [*Janthina striolata* Adams & Reeve, newly added to the Japanese Molluscan fauna.] *Ibid.*, 13 (5-8), pp. 316-317.
- MIYADI, D., HABE, T., IMAIZUMI, T., AMANO, H. & YAMANE, K. [宮地傳三郎・波部忠重 今泉正・天野宏・山根謙爾]: 浦内灣に於ける内灣度と潮間帶並びに底棲群衆との關係 [On the ecological embayment index of the Urauchi-wan, with special reference to the benthic and intertidal communities.] 日本海洋學會誌 [*Jour. Ocean. Soc. Japan*], 3 (4), pp. 207-215.
- MIYADI, D., MASUI, T. & HABE, T. [宮地傳三郎・増井哲夫・波部忠重]: 内灣度と内灣の生

- 物群聚型に就て [On the ecological embayment index and the types of benthic biocoenoses in bays] 京都大學生理生態學研究業績 [Rep. on Physiol. & Ecol., Kyoto Imp. Univ.], No. 3, pp. 1-20, pl. 1. (Mimeographed)
- MORI, Syuiti [森主一]: ウミシヤボテン *Cavernularia obesa* Valenciennes の日週期活動, III. 光による活動の制御 (1) [Daily rhythmic activity of the sea pen *Cavernularia obesa* Valenciennes, III. Controlling of the activity by means of light.] 動物雑誌 [Zool. Mag.], 56 (4-6), pp. 81-85.
- : „ IV. 冬季に於ける活動の観察 [„ IV. Observations on activity in winter.] *Ibid.*, 56 (4-6), pp. 86-90.
- : „ V. 冬季に於ける恒明及恒暗状態下の活動と水温の影響 [„ V. Activity under constant brightness and darkness in winter and influence of water temperature.] *Ibid.*, 56 (4-6), pp. 91-95.
- : „ VI. 自律週期の解析 (1) [„ VI. Analysis of the endogeneous rhythmicity (1).] *Ibid.*, 56 (4-6), pp. 96-100.
- : „ VII. 光反應の終夜變化 [„ VII. Change of photo-reaction at all night.] *Ibid.*, 56 (4-6), pp. 101-104.
- : 木造船加害動物防除に関する二三の知識 [Some knowledges on the protection of wooden ships against marine borers] 色材協會誌 [Sikizai-Kyokai-Si], 18 (5), pp. 124-125.
- : クレオソート注入材の防蟲効果 [Efficiency of creosote-injected wood against marine borers.] 木船蟲害防除研究者連絡通信 [Marine Borers Researchers Information], No. 7, pp. 1-4. (Mimeographed)
- NOZAWA, Kanefumi [野澤兼文]: Studies on the nucleo-plasmic ratio. III. The ratio in the ciliate, *Glaucoma pyriformis*. *Cytologia*, 13 (3-4), pp. 360-368. [* 120]
- : 船喰蟲幼生雜記 [Notes on the larvae of shipworms.] 色材協會誌 [Sikizai-Kyokai Si], 18 (5), pp. 120-124.
- ONO, Kisaburo [小野喜三郎]: 常蟲の刺激生理學的研究, I, [Stimulus-physiological studies on *Phoronis australis*. I.] 京都大學生理生態學研究業績 [Rep. on Physiol. & Ecol., Kyoto Imp. Univ.], No. 10, pp. 1-11, pls. 1 & 2.
- TAMURA, Tadashi [田村正]: 外圍の變化が魚類に及ぼす影響. 第八報 環境水の變化が魚類の呼吸運動並に呼吸頻度に及ぼす影響 [The influence of the change of external medium upon the fishes. Part. 8. The influence of the change of the surrounding water upon the respiratory movement and respiration frequency of the fishes.] 水産雑誌 [Jour. Fish.], No. 52, pp. 50-63.
- UCHIDA, Hajime: Die Bestätigung der nicht beschriebenen Art, *Heterolepisma dispar* Silv. (Thysanura). *Annot. Zool. Japon.*, 22 (4), pp. 185-189.
- UTINOMI, Huzio [内海富士夫]: Studies on the animals inhabiting reef corals. III. A revision of the family Hapalocarcinidae (Brachyura), with some

remarks on their morphological peculiarities. *Palao Trop. Biol. Sta Studies*, 2 (4), pp. 687-731, pls. 3-5. [* 119]

———: 南洋群島科學文獻集 [Bibliographia Micronesica, scientiae naturalis et cultus. iii+208 pp.] 北隆館 [Hokuryukan Book Co.], Tokyo.

1945 (昭和 20 年)

HABE, Tadashige [波部忠重]: 日本産海産腹足類の歯舌に就いて (2) [On the radulae of Japanese marine gastropods (2).] 貝類雜 [Jap. Jour. Malac.], 14 (1-4), pp. 1-9.

———: 貝類の自割 [Autotomy of shells.] *Ibid.*, 14 (1-4), p. 152.

———: 美味な貝 [Delicious shells.] *Ibid.*, 14 (1-4), pp. 152-153.

———: 浦神灣の底棲動物群聚並びに潮間帯のタマキビ層に就て [On the benthic communities and *Tectarius Littorivaga* association in the intertidal zone in Uragami wan.] 日本海洋學會誌 [Jour. Ocean. Soc. Japan.], 4 (1), pp. 1-6.

HABE, T., KAWAGUCHI, M. & YAMANE, K. [波部忠重・川口正雄・山根謹爾]: 若狭小濱灣に於ける遺骸群聚の研究 [Studies on the benthic thanatocoenoses of the Obama-wan, Prov. Wakasa.] 京都大學生理生態學研究業績 [Rep. on Physiol. & Ecol., Kyoto Imp. Univ.], No. 32, pp. 1-23, pls. 1-10. (Mimeographed)

HABE, T., KAWAGUCHI, M., YAMANE, K. & NOMURA, S. [波部忠重・川口正雄・山根謹爾・野村茂夫]: 瀬戸内海の内灣の研究. II. 松永灣の底棲群聚と貝殻死殻の堆積 [Studies on embayments of the Seto-naikai (Seto Inland Sea). III. Benthic communities and dead shell deposit in the Matsunaga wan.] *Ibid.*, No. 22, pp. 1-9, pls. 1-2. (Mimeographed)

HABE, T., YAMANE, K., KATO, S. & YAMAZI, J. [波部忠重・山根謹爾・加藤鈺郎・山路勇]: 大崎灣の底棲群聚. 小さい内灣に於ける内灣度の発達型式に就て [Benthic communities of the Ōsaki-wan, with special reference to the advanced degree of the embayment characters in small inlet.] *Ibid.*, No. 21 pp. 1-9, pls. 1 & 2. (Mimeographed)

KOMAI Taku & YAMAZI, Isamu: Order found in the arrangement of organs and zooids in some medusae. *Annot. Zool. Japon.*, 23 (1), pp. 1-7.

KURODA, Tokubei [黒田徳米]: 日産新貝類 (6) [New Japanese shells (6).] 貝類雜 [Jap. Jour. Malac.], 14 (1-4), pp. 29-42, pls. 1 & 2. (26)

MIYADI, D., HABE, T., KAWAGUCHI, M. & YAMANE, K. [宮地傳三郎・波部忠重・川口正雄・山根謹爾]: 中ノ海の底棲動物群聚と遺骸群聚 [Benthic biocoenoses and thanatocoenoses of the Naka-no-umi.] 京都大學生理生態學研究業績 [Rep. on Physiol. & Ecol., Kyoto Imp Univ.], No. 31, pp. 1-24, pls. 1-3. (Mimeographed)

MORI, Syuiti [森主一]: 日週期活動の個性と勞務時刻 [Individuality of daily rhythmic activity and time of labour.] *Ibid.*, No. 18, pp. 1-10, pls. 1-6. (Mimeographed)

- : ウミシヤボテンの自律日週期活動 [Endogeneous daily rhythmic activity of the sea-pen, *Cavernularia obesa* Valenciennes.] *Ibid.*, No. 19, pp. 1-21, pls. 1-4. (Mimeographed)
- : コールタールクレオソート油注入材の本船塢害動物防除法としての利用 [Utilization of creosote coaltar injected woods for the protection of ship bottoms against marine borers.] *Ibid.*, No. 35, pp. 1-18. (Mimeographed)
- : 動物の行動週期と外界要因週期の聯關に關する一般の考察 [General consideration on the relation between the behavior rhythm of animals and the environmental rhythm.] *Ibid.* No. 39, pp. 1-42.
- TAKI, Iwao & HASE, Tadashige [波部忠重]: 日本産ニホガヒ超科の分類 [Classification of the superfamily Pholadacea in Japan.] 貝類雜 [Jap. Jour. Malac.], 14 (1-4), pp. 108-117. (27a)
- & ———: アンボン及びニコバル産船食蟲類 [Some shipworms from Ambon and Nicobar.] *Ibid.*, 14, (1-4), pp. 118-123. (27b)

1946 (昭和 21 年)

- HASE, Tadashige [波部忠重]: 勝浦灣の底棲群聚に就て [On the benthic communities of the Katsuura-wan.] 京都大學生理生態學研究業績 [Rep. on Physiol. & Ecol., Kyoto Imp. Univ.], No. 54, pp. 1-10, pl. 1. (Mimeographed)
- : 貝類死殻の堆積に就いて [On the deposits of Molluscan shells.] 鑛物と地質 [Minerals & Geology], 1 (1).
- : 日本産頭楯類數種に就いて [On some species belonging to the Cephalaspidea in Japan.] 貝類雜 [Jap. Jour. Malac.], 14 (5-8), pp. 183-190.
- : 日本産海産腹足類の齒舌に就いて (3) [On the radulae of Japanese marine gastropods (3).] *Ibid.* 14 (5-8), pp. 190-199.
- : 汽水産貝類新種 *Assimineea estuarina* ツブガハザンショウ [A new brackish-water gastropod, *Assimineea estuarina* Habe, n. sp.] *Ibid.*, 14 (5-8), pp. 217-218.
- : コフジガヒの新産地 [New locality of *Pseudopythina subsinuata* Lischke, commensal with *Squilla oratoria*.] *Ibid.*, 14 (5-8), p. 273.
- HASE, T., KAWAGUCHI, M. & YAMANE, K. [波部忠重・川口正雄・山根謹爾]: 若狭小濱灣の底棲動物群聚並にその底曳漁獲物との關係 [Benthic communities of the Obama-wan and their relation with the catch by dredging.] 京都大學生理生態學研究業績 [Rep. on Physiol. & Ecol., Kyoto Imp. Univ.], No. 55, pp. 1-33, pls. 1 & 2. (Mimeographed)
- HASE, T., YAMANE, K., KATO, S. & YAMADI, I. [波部忠重・山根謹爾・加藤鈺郎・山路勇]: 由良灣の底棲群聚. 再び小さい内灣に於ける内灣度の發達型式に就て [Benthic communities of the Yura-wan, with further consideration on the advanced degree of the embayment characters in small inlet.] *Ibid.* No. 56, pp. 1-14, pls. 1 & 2. (Mimeographed)

- MIYADI, D. & HABE, T. [宮地傳三郎・波部忠重]: 紀伊半島南部の古和灣・方座灣・神前灣及び槌柄灣の底棲動物群聚 [Benthic communities of the Kowa-wan, Hôza-wan, Kanzaki-wan and Tasikara-wan, along the southern coast of the Kii Peninsula.] *Ibid.* No. 57, pp. 1-17, pl. 1. (Mimeographed)
- MIYADI, D., HABE, T., KAWAGUTI, M., YAMANE, K. & YAMAZI, I. [宮地傳三郎・波部忠重・川口正雄・山根謹爾・山路勇]: 二枚貝ホトトギスとアマモに就て [On the mussel *Brachidon'es senhausia* and the eelgrass *Zostera marina*.] *Ibid.*, No. 59, pp. 1-18, pl. 1. (Mimeographed)
- MIYADI, D. & MORI, S. [宮地傳三郎・森主一]: 鐵筋コンクリート船底附着生物防除に關する研究 [Studies on the prevention of the fouling organisms on concrete ship bottoms.] *Ibid.*, No. 64, pp. 1-4. (Mimeographed)
- MIYADI, D. & TOYOHARA, G. [宮地傳三郎・豊原義一]: 與謝内海の変異とその對策 [Change of oceanographical conditions of the Yosa-naikai and their improvement for fisheries purposes.] 科學朝日 [Kagaku Asahi], 6 (10).
- TAKEDA, Nobuyuki [武田信之]: 船蝨幼生の趨化性に就いて (豫報) [On the chemotaxis of shipworm larvae. A preliminary report.] 生物 [Seibutu], 1 (2), pp. 109-112. (29)

1947 (昭和 22 年)

- INOE, Syumpei [猪野俊平]: 海藻の發生 [Embryological studies on marine algae.] 4+4+255 pp. 北隆館 [Hokuryukan Book Co.], Tokyo.
- KOMAI, Taku [駒井卓]: 腔腸動物の或種に見られる器官又は個蟲の集序式配列 [Phyllotaxis-like arrangement of organs or zooids found in some coelenterates.] 動物雜 [Zool. Mag.], 57 (7), pp. 98-100.
- : 日本産二種の淡水水母 [On two species of freshwater medusae occurring in Japan.] 生物 [Seibutu], 2 (1), pp. 15-17. (With English rés.) (*30)
- : 日本の動物. 上卷. [Animals of Japan. I.] 140 pp. 富書店 [Tomi-syoten Book Co.], Kyoto.
- MIYADI, Denzaburo & HABE, Tadashige [宮地傳三郎・波部忠重]: 内灣の遺骸群聚の研究 [On thanatocoenoses of bays.] 生理生態 [Physiol. & Ecol.], 1 (2), pp. 110-124. (With English rés.)
- MIYADI, D., HABE, T., KAWAGUCHI, M. & YAMAZI, I. [宮地傳三郎・波部忠重・川口正雄・山路勇]: 與謝内海の海況の遷移と漁獲減少に就て [On the hydrographical succession of the Yosa-naikai and the decline of its fisheries.] 動物雜 [Zool. Mag.], 57 (9), pp. 147-151.
- MORI, Syuiti [森主一]: ウミシヤボテン *Cavernularia obesa* Valenciennes の日週期活動. IX. 長期恒暗状態下の活動 [Daily rhythmic activity of the sea-pen, *Cavernularia obesa* Valenciennes. IX. Activity under constant darkness during

- 103 days.] 生理生態 [*Physiol. & Ecol.*], 1 (1), pp. 8-14. (With English rés.)
- UTINOMI Huzio [内海富士夫]: 日本近海兩ワレカラ類 [Caprellidae of Japan and adjacent waters.] 生物 [*Seibutu.*], Suppl. No. 1, pp. 68-82. (* 28)
- : 船とフデツボ [Ship and barnacles.] 國民科學文庫 [*National Science Library*], Ser. 2, No. 12. 124 pp. 日本出版社 [Nippon Syuppan-sya Book Co.], Osaka.

1948 (昭和 23 年)

- HONJO, Ichijiro [本城市次郎]: アコヤガイの刺激生理學的研究. I. 光反應 [Reizphysiologische Untersuchungen von *Pinctada martensi* (Dunker). I. Lichtreaktion.] 生理生態 [*Physiol. & Ecol.*], 2 (2), pp. 57-61.
- KOMAI, Taku [駒井卓]: 刺胞を有する櫛水母 (續報) [*Euchlora rubra*, a ctenophore provided with nematocysts (Supplementary note).] 動物雜 [*Zool. Mag.*], 58 (3-5), p. 67.
- KURODA, Tokubei [黒田徳米]: 日本産シャクシガヒ類の研究 [Studies on Japanese species of *Cuspidaria*.] 貝類雜 [*Jap. Jour. Malac.*], 15 (1-4), pp. 1-28, pls. 1 & 2.
- : 巨大なキヌタレガヒ屬の2新種 [Two new gigantic species of *Solemya*.] *Ibid.*, 15 (1-4), pp. 29-32.
- MIYADI, Denzaburo & HASE, Tadashige [宮地傳三郎・渡部忠重]: 與謝内海の海況と漁況の改善 [Studies on the Yosa-naikai, its oceanographic conditions and their improvement for fisheries purposes.] 日本水産學會誌 [*Bull. Jap. Soc. Sci. Fish.*], 14 (5), pp. 244-250. (With English rés.)
- MORI, Syuiti [森主一]: ウミシヤボテン *Cavernularia obesa* Valenciennes の日週期活動. X. 活動を制御する2種類の刺激 [Daily rhythmic activities of the sea-pen, *Cavernularia obesa* Valenciennes. X. Two kinds of stimulus which control the activities.] 生理生態 [*Physiol. & Ecol.*], 2 (1), pp. 34-38. (With English rés.)
- : アコヤガヒの日週期活動 [Daily rhythmic activities of "Martens" pearl-oysters (*Pinctada martensi* (Dunker)).] 貝類雜 [*Jap. Jour. Malac.*], 15 (1-4), pp. 46-51. (With English rés.)
- : 低壓 O₂ 海水中のアコヤガヒの呼吸 (豫報) [On the respiration of *Pinctada martensi* (Dunker) in the sea water of low oxygen tension (A preliminary note).] *Ibid.*, 15 (1-4), pp. 52-54. (With English rés.)
- : 木船害蟲と其の防除 [Marine borers and the protection of wooden ships against them.] 國民科學文庫 [*National Science Library*], Ser. 2, No. 13. 74 pp. 日本出版社 [Nippon Syuppan-sya Book Co.], Osaka.
- TAKEDA, Nobuyuki [武田信之]: 海産撓脚類 *Tigriopus japonicus* Mori の雌雄性に及ぼす外界の影響 III. 温度の影響及び水棲無脊椎動物の性決定に關する一般的考察 [Experimental studies on the external influence on the sexuality of the marine copepod

Tigriopus japonicus Mori. III. Effect of temperature with general consideration on the sex-determination in marine invertebrate animals.] 生物 [Seibutu], 3 (1), pp. 12-21, (With English rés.)

———: 海産無色鞭毛蟲の採集と飼育 [Collecting and culture of marine colourless flagellates.] 採集と飼育 [Collecting & Breeding], 10 (6), pp. 162-166.

TOKIOKA, Takasi [時岡隆]: 珍しい海の漂客 [Curious drifting animals of the ocean.] 科学知識 [Scientific Knowledge], 28 (8), pp. 1-7.

UTINOMI, Huzio [内海富士夫]: 海と生物 [The sea and marine animals.] たのしい科学 [Happy Science Library], No. 8. 160 pp. 文祥堂 [Bunsyodo Book Co.], Osaka.

———: 潮干符の動物観察 [Observations on intertidal animals at low tide.] 野外教室 [Yagai Kyositu], 2 (6), pp. 5-9.

1949 (昭和 24 年)

HABE, Tadashige [波部忠重]: Erodonidae in Japan (日本産ヌマコダキガヒ科. *Illust. Cat. Jap. Shells*, No. 1, pp. 1-6, pl. 1, [* 122])

———: ワタゾコアミガサに就いて [Notes on *Cocculina rhyssa* Dall.] 貝類雑 [Jap. Jour. Malac.], 15 (5-8), pp. 67-68. (With English rés.) (36a)

———: ナギサノツ属 *Oxynoe* 日本貝類群に加はる [The genus *Oxynoe*, new to Japanese Molluscan fauna.] *Ibid.*, 15 (5-8), pp. 79-80. (36b)

———: 日本産貝類2新種 [Descriptions of two new species of marine gastropods from Japan.] *Ibid.*, 15 (5-8), pp. 81-83. (With English rés.) (36c)

———: 田邊灣の底棲動物群落と貝類遺骸の堆積 [The benthic communities and molluscan thanatocoenoses of the Tanabe Bay.] 日本水産学会誌 [Bull. Jap. Soc. Sci. Fish.], 15 (5), pp. 238-244. (With English rés.)

KIRA, Tetsuaki & HABE, Tadashige [吉良哲明・波部忠重]: カフダカスカシガヒ属の日本産の種類に就いて [Notes on Japanese species of the genus *Puncturella* (Fissurellidae.)] 貝類雑 [Jap. Jour. Malac.], 15 (5-8), pp. 84-89. (37)

KOMAI, Taku [駒井卓]: 動物學上著明な日本産動物 [Zoologically remarkable animals in Japan.] 212 pp., 1 pl. 甲文社 [Kôbunsha Book Co.], Kyoto.

KONDO, Kinsuke, MORI, Shigeki & KAWAI, Fumio [近藤金助・森茂樹・河合文雄]: 生体觸媒に関する研究 (第9報) 海藻の Carbonic anhydrase に就て [On the bio-catalyses. IX. On the carbonic anhydrase of sea-weed.] 化研講演集 [Rep. Inst. Chem. Res. Kyoto Univ.], No. 19, pp. 68-69. (38)

KUBO, Itsuo: Studies on the penaeids of Japanese and its adjacent waters. *Jour. Tokyo Coll. Fish.* (formerly *Jour. Imp. Fish. Inst.*), 36 (1), pp. 1-467.

KURODA, Tokubei [黒田徳米]: 新属新種ウラシマカタベに就いて [On *Kiramodulus*

- lacteus*, a new gastropod.] 貝類雜 [Jap. Jour. Malac.], 15 (5-8), pp. 72-75. (With English descr.) (35a)
- : キゼキトゲニナの記載 [On *Argyropeza izekiana* Kuroda n. sp.] *Ibid.*, 15 (5-8), pp. 76-79. (With English descr.) (35b)
- KURODA, Tokubei & HABE, Tadashige [黒田徳米・波部忠重]: タフガタガヒ科 Pyramidellidae の自然分類上の位置について [On the systematic position of Pyramidellidae.] *Ibid.*, 15 (5-8), pp. 55-58. (34a)
- & ———: 日本産ワタゾコシロガサ類 [On the gastropod genus *Cocculina* from Japan.] *Ibid.*, 15 (5-8), pp. 58-67, pl. 3. (With English descr.) (34b)
- & ———: エゾタマガヒ及びそれと混同せられてゐた種に就いて [On *Nalica janthostoma* and an allied species which was confused with it.] *Ibid.*, 15 (5-8), pp. 69-72. (34c)
- MORI, Syuiti [森主一]: Harmony between behavior rhythm and environmental rhythm. *Mem. Coll. Sci. Univ. Kyoto*, Ser. B, 19 (2), pp. 71-74.
- : ウミシヤボテン *Cavernularia obesa* Valenciennes の日週期活動. XI. 光による活動の制御 (2) [Daily rhythmic activities of the sea pen, *Cavernularia obesa* Valenciennes. XI. Controlling of the activity by light (2).] 生理生態 [Physiol. & Ecol.], 3 (1-2), pp. 32-37. (With English rés.) (32)
- SHINO, Suetō M.: On two new species of the bopyrid genus *Bopyrella* found in Japan. *Bull. Biogeogr. Soc. Japan*, 14 (9), pp. 45-50.
- : On the new genera of Bopyridae found in Japan. *Ibid.*, 14 (11), pp. 57-63.
- TAKEDA, Nobuyuki: Some abnormalities found in the marine copepod, *Tigriopus japonicus* Mori. *Jap. Jour. Genetics*, 24 (5-6), pp. 125-128. (With Japanese rés.) [* 143]
- TAKI, Iwao [瀧巖]: 和歌山縣産頭足類目録草稿 [Annotated list of the Cephalopoda occurring in the Wakayama Prefecture (Preliminary report).] 南紀生物 [Nanki Seibutu], 1 (2), pp. 47-54. (Mimeographed.)
- TAMURA, Tadashi [田村正]: 外圍の變化が魚類に及ぼす影響 (第 10 報). 數種海産魚類の稀釋海水中に於ける致死時間と體重變化並に體各部の含水量變化に就いて [The influence of the change of external medium upon the fishes. X. The survival time, changes of body weight and the water contents of some organs of marine fish which are living in diluted sea water.] 水産雜 [Jour. Fish.], No. 54, pp. 48-71, (With English rés.)
- TOKIOKA, Takasi: Contributions to the Japanese Ascidian fauna. I, Ascidians collected by Prof. Miyadi and Mr. Masui during the bottom survey 1939-40. *Publ. Seto. Mar. Biol. Lab.*, 1 (1), pp. 1-17, pls. 1-7. (* 121)
- : Contribution to Japanese Ascidian fauna. II, Notes on some ascidians collected chiefly along the coast of Kii Peninsula. *Ibid.*, 1 (2), pp. 39-64, pl. 8. (124)

- : Droplets from the plankton net. I, *Metacercaria pelagica*, n. sp., a floating furcocercous cercarian. II, Notes on *Echinoderes* found in Japan. III, Record of a *Chaetosoma* specimen found near Seto. IV, *Haemocera morii* n. sp., a curious copepod belonging to the family Monstrillidae. *Ibid.*, 1 (2), pp. 65-73. [125]
- UTINOMI, Huzio [内海富士夫]: Studies on the Cirripedian fauna of Japan. VI. Cirripeds from Kyusyu and Ryukyu Islands. *Ibid.*, 1 (2), pp. 19-37. [123]
- : Further notes on cirripeds from the Ogasawara Islands. *Pacific Science*, 3 (1), pp. 93-99.
- : 日本産蔓脚類の研究. I. 分類と種の分化 [Studies on the Cirripedia of Japan. I. Classification and differentiation of species.] 生物 [Seibutu], 4 (2), pp. 62-70. (* 31)
- : 潮間帯生物の棲所型 [Habitat-types of intertidal organisms.] 動物雑 [Zool. Mag.], 58 (3-5), pp. 59.
- : 畔田翠山の『水族志』にのせられた海蟲類 [On the marine worms mentioned in the "Suizokushi" by Suizan Kuroda.] 南紀生物 [Nanki Seibutu], 1 (1), pp. 1-2. (Mimeographed).
- : 紀州における南方系のウニ類 [Echinoids of tropical element occurring in the waters of Prov. Kii.] *Ibid.*, 1 (2), pp. 55-56. (Mimeographed). (33)

1950 (昭和 25 年)

- HABE, Tadashige [波部忠重]: Ringiculidae and Retusidae (1) in Japan (日本産マメウラシマガヒ科及びヘコマツララガヒ科, I.). *Illust. Cat. Jap. Shells*, No. 2, pp. 7-16, pl. 2. [* 126]
- : Hydatinidae, Bullidae and Akeridae in Japan (日本産ミスガヒ科, ナツメガヒ科, ウツセミガヒ科). *Ibid.*, No. 3, pp. 17-24, pl. 3. [* 127]
- : Myochamidae in Japan (日本産ミツカドカタビラガヒ科). *Ibid.*, No. 4, pp. 25-30, pl. 4. [128]
- : Pupidae in Japan (日本産カヤノミガヒ科). *Ibid.*, No. 6, pp. 39-43, pl. 8. [133a]
- : A new parasitic eulimid, *Balcis komaii* new species. *Ibid.*, No. 6, pp. 44. [133b]
- : Sexual-dimorphism in *Japeuthria ferrea*. *Ibid.*, No. 6, pp. 44. [133c]
- : Philinidae in Japan (日本産キシワタガヒ科). *Ibid.*, No. 8, pp. 48-52, pl. 9. [135]
- : Solemyidae in Japan (日本産キヌタレガヒ科). *Ibid.*, No. 10, pp. 61-64. [150]
- : 田邊灣に於ける貝類の生態的分布 [On the ecological distribution of Mol-

- luscan shells in Tanabe Bay.] 貝類雜 [Venus: Jap. Jour. Malac.], 16 (1-4), pp. 13-18. (49)
- HIROTA, Takeo [廣田猛夫]: 熱力學的に考へられる Zytokinese の四型式 [Four types of zytokinese, as considered thermodynamically.] 動物雜 [Zool. Mag.], 59 (2-3), pp. 66-64.
- KAMOHARA, Toshiji [蒲原稔治]: 土佐及び紀州の魚類 [Description of the fishes from the provinces of Tosa and Kisyu, Japan.] 288+5+48+27 pp. 高知文教協會 [Kôchi-Bunkyo-Kyôkai], Koti.
- KANAMARU, Tajima [金丸但馬]: 紀州貝類採集史 [A history of the collection of shells in Province Kii.] 貝類雜 [Venus: Jap. Jour. Malac.], 16 (1-4), pp. 18-25.
- KONDO, Kinsuke, MORI, Shigeki & KAWAI, Fumio: Studies on biocatalyses. (XIII) Boron in sea-weeds. *Bull. Inst. Chem. Res. Kyoto Univ.*, No. 22, p. 97. [* 149]
- KURODA, Tokubei [黒田徳米]: 日本産現棲貝類 [An outline of the recent Molluscan fauna of Japan.] 貝類雜 [Venus: Jap. Jour. Malac.], 16 (1-4), pp. 1-12. (47)
- : 喜壽翁神田耕一郎先生を頌え海産巻貝 2 新種に献名す [Descriptions of two new species of marine gastropods, dedicated to Mr. Kanda on his 77th birthday.] *Ibid.*, 16 (1-4), pp. 49-52. (48)
- : The recent Molluscan fauna of Japan. *Jour. de Conchyliologie*, No. 90, pp. 200-207.
- KURODA, Tokubei & HABE, Tadashige: Volutidae in Japan (日本産ヒタチオビ科). *Illust. Cat. Jap. Shells*, No. 5, pp. 31-38, pls. 5-7. [129]
- & ———: Eulimidae in Japan (1) (日本産クリムシガヒ科, 1) *Ibid.*, No. 9, pp. 53-59, pl. 10. [136a]
- & ———: Two new parasitic eulimids. *Ibid.*, No. 9, p. 60. [136b]
- MAWATARI, Shizuo [馬渡静夫]: 海中木材蝕害動物とその防除の研究 [Biological and industrial study of marine borer problem in Japan.] 岡田綱一郎編: “水産動物の研究” (I) Y. OKADA'S “Studies on the aquatic animals of Japan” (I), pp. 45-124, (9)-(12), 1 pl. (With English rés.)
- MIYADI, D., HABE, T., KAWAGUTI, M. & YAMAZI, I. [宮地傳三郎・波部忠重・川口正維・山路勇]: 舞鶴灣の水産の海洋生物學的調査 [Benthonic biocoenoses and thanatocoenoses of the Maizuru Bay.] *Ibid.*, 1, pp. 33-34, (7)-(8). (With English rés.) (* 46)
- MIYADI, D., HABE, T. & YAMAZI, I. [宮地傳三郎・波部忠重・山路勇]: 非調和型の内灣及び潟とその改善。(附) 久美濱灣について [On the benthos and shell deposits of Kumihama Bay, a lagoon on southwestern Japan Sea coast.] *Ibid.*, 1, pp. 25-32, (5)-(6). (With English rés.) (* 45)

- MORI, Syuiti [森主一]: ウミシヤボテン *Cavernularia obesa* Valenciennes の日週期活動. XII. 結論——環境, 行動, 体内生理状態の連關をめぐる問題 [Daily rhythmic activity of the sea-pen, *Cavernularia obesa* Valenciennes. XII. Conclusions—Problems on relation among environments, behaviors and internal physiological conditions.] 生理生態 [Physiol. & Ecol.], 4 (1-2) pp. 12-20. (With English rés.) (* 54)
- MORI, Syuiti & MATUTANI, Kozi [森主一・松谷幸司]: トゲモジガイの日週期活動 I. 活動一般について [Daily rhythmic activity of the sea star. *Astropecten polyacanthus* Müller et Troschel. I. On the activities in general.] 動物雜 [Zool. Mag.], 59 (2-3), p. 66.
- & ——: トゲモジガイの日週期活動 II. 活動に及ぼす飢餓の影響 [Daily rhythmic activity of the sea star, *Astropecten polyacanthus* Müller et Troschel. II. Influence of starvation on the activities.] *Ibid.*, 59 (2-3), pp. 66-97.
- NOZAWA, Kanefumi: Studies on the nucleo-plasmic ratio. I General problems, with special reference to the ratio in the Protozoa. *Annot. Zool. Japon.*, 23 (4), pp. 135-174. [137]
- OJIMA, Yoshio [小島吉雄]: アコヤガイ外套膜の組織學的研究. 特に腺細胞に關する觀察 [Histological studies on the mantle of pearl oyster, *Pinctada martensi* (Dunker). Microscopical observations on the glandular cells.] 生物 [Seibutu], 4 (5-6), pp. 201-205. (With English rés.)
- OKADA, Yô K. [岡田要]: 雙尾のハコフグ [A coffer-fish with double caudal fins.] 動物雜 [Zool. Mag.], 59 (1), p. 8. (With English rés.)
- OKUDA, Shiro: Note on some commensal polychaetes from Japan. *Annot. Zool. Japon.*, 24 (1), pp. 49-53. [152]
- OYAMA, Heisaburo & KAWAKAMI, Izumi [雄山平三郎・川上泉]: ウエの卵と精子に及ぼす超音波の影響 [The influence of super-sonic waves on echinoid eggs and sperms.] 動物雜 [Zool. Mag.], 59 (2-3), p. 39.
- SAKAI, Tane [酒井恒]: 紀州の蟹 [Crabs of Prov. Kii.] 南紀生物 [Nanki Seibutu], 1 (3), pp. 132-133. (Mimeographed).
- SETO MARINE BIOLOGICAL LABORATORY [瀬戸臨海實驗所]: 水族館の24時間 [24 hours of aquarium.] 目で見る社會科, 23 集 [Medemiru Syukai-ka, No. 23.] 46 pp. Mainichi Press., Osaka-Tokyo. (41)
- SHINO, Suetō [椎野季雄]: イセエビ卵の發生上に於ける二三の點に就いて [On some points of the embryonic development of *Panulirus japonicus* (von Siebold).] 動物雜 [Zool. Mag.], 59 (2-3), p. 47.
- : 伊勢蝦の胚期發生に關する研究 [Studies on the embryonic development of *Panulirus japonicus* (von Siebold).] 三重縣大水產學部紀要 [Jour. Fac. Fish. Pref. Univ. Mie], 1 (1), pp. 1-168, pls. 1-25. (With English rés.)
- TAKEDA, Nobuyuki: Experimental studies on the effect of external agencies

- on the sexuality of a marine copepod. *Physiological Zoology*, 23 (4), pp. 288-301. [** 142*]
- TAKI, Isao & TAKI, Iwao [澤庸・龍巖]: 和歌山縣産ヒザラガイ類目録 [Annotated list of chitons occurring in the Wakayama Prefecture.] 南紀生物 [*Nanki Seibutu*], 1 (3), pp. 122-126. (Mimeographed). (39)
- TAKI, Iwao & HABE, Tadashige: Xylophaginidae in Japan (日本産キクヒガヒ科). *Illust. Cat. Jap. Shells*, No. 7, p. 45-47. [*134*]
- TAMURA, Tadashi [田村正]: 外圍の變化が魚類に及ぼす影響. 第 11 報. 綜合考察 [The influence of the change of external medium upon fish. XI. General consideration.] 水産科研報告 [*Jour. Inst. Res. Sci. Fish. Hakodate Coll. Fish.*], No. 2, pp. 1-35. (With English rés) (39)
- TOKIOKA, Takasi [時岡隆]: Ascidians from the Palao Islands. I. *Publ. Seto Mar. Biol. Lab.*, 1 (3), pp. 115-150, pl. 9. [*146*]
- : Droplets from the plankton net. V, New names for egg capsules of littorinid gastropods. VI, Notes on the posterior protuberances found in some fritillarians. VII, Record of a *Thliptodon* found near Seto. VIII, Occurrence of two species of *Chaetoceros* in the city of Peking. *Ibid.*, 1 (3), pp. 151-157. [*147*]
- : 海産プランクトン圖説 (1) 鞭藻類 [Illustrations of marine plankton. I. Dinoflagellata (Peridinales, Peridineae).] 臨海實習の栞 [*Guide to Marine Biological Practicum*], No. 1, pp. 1-5, pls. 1-4. (Mimeographed.)
- : 海産プランクトン圖説 (2) 珪藻類 [Illustrations of marine plankton. 2. Diatom: Bacillariophyceae (Bacillariales, Diatomaes).] *Ibid.*, No. 2, pp. 1-29, pls. 1-12.
- : 深海動物の眼の問題と矢蟲類 [Notes on the development of the eye and the vertical distribution of Chaetognatha] 自然と文化 [*Natura & Cultura*], No. 1, pp. 117-132. (With English rés.) [** 132*]
- TOKIOKA, Takasi & YAMAZI, Isamu [時岡隆・山路勇]: 英虞灣の眞珠漁場に關する研究. 第 2 報. 英虞灣プランクトンの量的分布 [Studies on the pearl fishery ground of the Ago Bay. II. Quantitative distribution of plankton in the Ago Bay.] 京都大學生理生態學研究業績 [*Rep. on Physiol. & Ecol., Kyoto Univ.*] No. 70, p. 5-18. (52)
- & ———: 英虞灣の眞珠漁場に關する研究. 第 3 報. 英虞灣プランクトンの質的分布 [Studies on the pearl fishery ground of the Ago Bay. III. Qualitative distribution of plankton in the Ago Bay.] *Ibid.* No. 71, pp. 19-61. (53)
- UTINOMI, Huzio [内海富士夫]: A new remarkable coral-boring Acrothoracican cirriped. *Mem. Coll. Sci. Univ. Kyoto*, Ser. B, 19 (3), pp. 83-89, pl. 1. [*130*]
- : On another form of Acrothoracica, newly found from Formosa. *Ibid.*, 19 (3), pp. 91-96. [*131*]

- : On a new primitive alcyonarian, *Cornularia komaii* n. sp. from Japan. *Publ. Selo Mar. Biol. Lab.*, 1 (3), pp. 75-80. [143]
- : Some xeniid alcyonarians from Japan and adjacent localities, *Ibid.*, 1 (3), pp. 81-91. [144]
- : *Clavularia racemosa*, a new primitive alcyonarian found in Japan and Formosa. *Annot. Zool. Japon.*, 24 (1), pp. 38-44. [151]
- : 原始八放珊瑚類 *Cornularia* の新発見 [Discovery of a primitive alcyonarian genus *Cornularia* in Japan.] 科學 [Science], 20 (1), pp. 37-38.
- : 海の寶庫—紀州 [A treasure ground of the sea-Kii.] きのくに [Kinokuni], No. 3, pp. 28-29.
- : 紀州の海蜘蛛類 (紀州南部沖底曳採集品記録, 第1報) [Pycnogonida from Kii Province (Record of collections dredged from off Minabe, Prov. Kii, I.)] 南紀生物 [Nanki Seibutu], 1 (3), pp. 127-132. (Mimeographed) (40)
- : 田邊灣沖底曳漁で採れるエビ類 (紀州南部沖底曳採集品記録, 第2報) [Shrimps caught by trawl fishery off Tanabe Bay (Record of collections dredged from off Minabe, Prov. Kii, II.)] *Ibid.*, 1 (4), pp. 195-199. (42)
- : 南部沖底曳網で採れたカニ類 (紀州南部沖底曳採集品記録, 第3報) [Crabs obtained by trawl-net off Minabe, Prov. Kii (Record of collections dredged from off Minabe, Prov. Kii, III.)] *Ibid.*, 2 (1), pp. 7-11, (Mimeographed) (44)
- : 田邊灣附近の底曳で採れる蔓脚類 (紀州南部沖底曳採集品記録, 第4報) [Cirripeds commonly taken by dredging near Tanabe Bay (Record of collections dredged from off Minabe, Prov. Kii, IV.)] *Ibid.*, 2 (2), pp. 60-65. (Mimeographed) (50)
- : 潮間帯生物群聚の棲所に基づく生態區分 [Ecological division of intertidal biocoenoses based on the types of habitats.] 生理生態 [Physiol. & Ecol.], 4 (1-2), pp. 50-59. (With English rés.) (55)
- : 尖腕類總説 [General account of the Acrothoracica.] 中村健兒編: "現代生物學の諸問題 [K. NAKAMURA'S "Some problems of modern biology"], pp. 428-461. 増進堂 [Zôshindô Book Co.], Osaka.
- UTINOMI, Huzio, YAMAZI, Isamu & IKARI, Miho [内海富士夫・山路勇・井狩美保]: タイドプールの生態. I. 環境要素としての地形的及び潮汐條件 [The ecology of tide pools. I. Topographical and tidal conditions as environmental factors.] 京都大學生理生態學研究業績 [Rep. on Physiol and Ecol., Univ. Kyoto], No. 66, pp. 1-5. (With English rés.) [139]
- & ———: タイドプールの生態. II. 環境要素としての氣象的及び水理學的條件 [The ecology of tide pools. II. Meteorological conditions as environmental factors.] *Ibid.*, No. 67, pp. 6-14. (With English rés.) [140]
- & ———: タイドプールの生態. III. プールの生物相の組成とその消長 [The ecology of tide pools. III. Biota of tide pools, their composition and fluctuation.] *Ibid.*, No. 68, pp. 15-23. (With English rés.) [141]

- YAMAZI, Isamu [山路勇]: Autotomy and regeneration in Japanese sea-stars and ophiurans. I. Observations on a sea-star, *Coscinasterias acutispina* Stimpson and four species of ophiurans. *Annot. Zool. Japon.*, 23 (4), 175-186. [138]
- : Plankton investigation in inlet waters along the coast of Japan. I. Introductory notes and the plankton of Akkeshi Bay, Hanasaki Inlet and Nemuro Harbour. *Publ. Seto Mar. Biol. Lab.*, 1 (3), pp. 93-113. [145]
- : 生活環境の理化學的觀察, I [Physical and chemical observations of viable environments, I.] 南紀生物 [Nanki Seibutu,], 2 (1), pp. 17-22. (Mimeographed) (43)
- : 生活環境の理化學的觀察, II. [Physical and chemical observations of viable environments, II.] *Ibid.*, 2 (2), pp. 73-75. (Mimeographed) (51)

1951 (昭和 26 年)

- HABE, Tadashige [波部忠重]: Scissurellidae in Japan (日本産クチキレエビスガヒ科) *Illust. Cat. Jap. Shells*, No. 11, pp. 65-70, pl. 11. [155]
- : Donacidae and Myidae in Japan (日本産フヂノハナガヒ科及びエゾオホノガヒ科). *Ibid.*, No. 12, pp. 71-78, pl. 12. [162]
- : Littorinidae in Japan (1) (日本産エゾタマキビガヒ科. 1). *Ibid.*, No. 14, pp. 87-93, pl. 14. [165a]
- : New parasitic gastropods. *Ibid.*, No. 14, pp. 93-94. [165b]
- : Petricolidae, Cardiliidae and Anatinellidae in Japan (日本産イハホリガヒ科, キサガヒモドキ科, チトセノハナガヒ科). *Ibid.*, No. 15, pp. 95-100, pl. 15. [168]
- : Marginellidae and Hydrocenidae in Japan (日本産コゴメガヒ科及びゴマヲカタニシ科). *Ibid.*, No. 16, pp. 101-108. [169]
- : Fissurellidae in Japan (1) (日本産スカシガヒ科. 1). *Ibid.*, No. 17, pp. 109-120, pl. 17. [171]
- : 日本産貝類概説. 斧足綱(二枚貝類)第1冊 [Genera of Japanese shells. Pelecypoda No. 1.] pp. 1-96. Kyoto.
- : 日本産貝類概説. 斧足綱(二枚貝類)第2冊 [Genera of Japanese shells. Pelecypoda No. 2.] pp. 97-186. Kyoto.
- HUKUDA, Hideo [福田英夫]: アラレタマキビ *Tectarius granularis* (Gray) の棲息密度とその変動 [Population density of the snail, *Tectarius granularis* (Gray) and its fluctuation,] 動物雑 [Zool. Mag.], 60 (1-2), pp. 41-42.
- : アラレタマキビの移動と潮位 [The movement of the snail, *Tectarius granularis* (Gray) on a stone-wall in relation to ebb and flow.] 生理生態 [Physiol. & Ecol.], 4 (3-4), pp. 28-37. (With English rés) (63)

- KOMAI, Taku: The nematocysts in the ctenophore *Euchlora rubra*. *Amer. Naturalist*, 85 (820), pp. 73-74. [153]
- : Phyllotaxis-like arrangement of organs and zooids in some medusae. *Ibid.*, 85 (820), pp. 75-76. [154]
- KOSHIMIZU, Takuji [小清水卓二]: ハマオモト雑記 [Notes on *Crinum asiaticum* var. *japonicum* (Baker).] 南紀生物 [Nanki Seibutu], 2 (3-4), pp. 146-148. (Mimeographed)
- KUBO, Itsuo: Some macrurous decapod Crustacea found in Japanese waters, with descriptions of four new species. *Jour. Tokyo Univ. Fish.*, 38 (2), pp. 259-289.
- MAEDA, Hiroshi [前田弘]: Analytical studies on marine lamp communities. *Publ. Seto Mar. Biol. Lab.*, 1 (4), pp. 195-213. [161]
- : 集魚燈動物の群集生態學的研究. 1. 相互の食性と驅逐關係 [Synecological studies on marine lamp communities. 1. Food-relation and dispersive ability.] 魚類雜 [Jap. Jour. Ichthyol.], 1 (6), pp. 349-360. (With Englist rés.)
- MAWATARI, Shizuo [馬渡静夫]: コケムシ類の採集・保存・研究法 (1) [Collecting, preserving and observing methods of bryozoans. (1)] 南紀生物 [Nanki Seibutu], 3 (1), pp. 20-24. (Mimeographed)
- MIYADI, Denzaburo & HABE, Tadashige [宮地傳三郎・波部忠重]: 英虞灣の眞珠漁場に關する研究. 第6報 貝類分布より見たる英虞灣深谷水道の影響に就いて [Studies on the pearl fishery ground of the Ago Bay. VI. On the influence of the Hukaya Channel, as considered from the distribution of Molluscan shells.] 京都大學生理生態學研究業績 [Rep. on Physiol. & Ecol., Kyoto Univ.], No. 74, pp. 32-34. (60)
- MIYAKE, Sadayoshi [三宅貞祥]: 紀州產異尾類目錄 [Annotated list of anomurans occurring in the province of Kii.] 南紀生物 [Nanki Seibutu], 2 (3-4), pp. 127-140. (Mimeographed) (56)
- OJIMA, Yoshio [小島吉雄]: アコヤガイ外套膜の組織學的研究 [Histological studies on the mantle of *Pinctada martensi* (Dunker),] 動物雜 [Zool. Mag.], 60 (1-2), p. 55.
- OYAMA, Katura: Amusiinae in Japan (日本產ツキヒガヒ亞科). *Illust. Cat. Jap. Shells*, No. 13, pp. 79-86. [165]
- SHIINO, Sueo M. [椎野季雄]: *Danalia* に就いて [On *Danalia*.] 動物雜 [Zool. Mag.], 60 (1-2), p. 36.
- : 日本產沿岸性タナイス目に就いて [On the littoral Tanaidea found in Japan.] *Bull. Biogeogr. Soc. Japan*. 15 (1), pp. 37-38. (With English r.s.)
- : 日本產沿岸性タナイス科3種に就いて [Note on three species of Tanaidae from Japanese coast.] 資源研彙報 [Misc. Rep. Res. Inst. Nat. Resources], Nos. 19-21, pp. 32-38. (58)
- : On two new species of the family Aseudidae found at Seto. *Rep. Fac. Fish. Pref. Univ. Mie*, 1 (1), pp. 12-25. [170]

- : 日本産魚類に寄生する等脚類に就いて [On the Cymothoid Isopoda parasitic on Japanese fishes.] 日本水産學會誌 [Bull. Jap. Soc. Sci. Fish.], 16 (12), pp. 81-89. (With English rés.)
- TOKIOKA, Takasi: The fauna of Akkeshi Bay, XVIII. Ascidia. (Contribution to Japanese Ascidian fauna. II). *Publ. Akkeshi Mar. Biol. Sta.*, No. 1, p. 1-22, pls. 1 & 2. [156]
- : Contributions to Japanese Ascidian fauna. IV. Notes on some ascidians collected in Osaka Bay (1). *Publ. Seto Mar. Biol. Lab.* 1 (4), pp. 169-182, pl. 11. [158]
- : Droplets from the plankton net. IX, Record of *Cyclosalpa bakeri* from Japanese waters. X, Record of *Creseis chierchiae* (Boas) from the Palao Islands. *Ibid.*, 1 (4), pp. 183-184. [159]
- : Pelagic tunicates and chaetognaths collected during the cruises to the New Yamato Bank in the Sea of Japan. *Ibid.*, 2 (1), pp. 1-25. [166]
- TOKIOKA, Takasi, YAMAZI, Isamu & HUSE, Sinitiro [時岡隆・山路勇・布施慎一郎]: 英虞灣の眞珠漁場に関する研究. 第5報, 深谷水道の船越浦に對する影響程度の推察 [Studies on the pearl fishery ground of the Ago Bay. V. Some considerations on the degree of influence of the Hukaya Channel upon the Hunagosi-ura] 京都大學生理生態學研究業績 [Rep. on Physiol. & Eco., Kyoto Univ.], No. 73, pp. 1-31, pl. 1. (59)
- UTINOMI, Huzio [内海富士夫]: 八放珊瑚類の一新型 [A new type of Alcyonaria.] 動物雜 [Zool. Mag.], 60 (1-2), pp. 35-36.
- : *Asterospicularia lauræ*, n. gen. et. n. sp. the type of a new family of alcyonarians with stellate spicules. *Pacific Science*, 5 (2), pp. 190-196. [163]
- : On some pycnogonids from the sea around Kii Peninsula. *Publ. Seto Mar. Biol. Lab.*, 1 (4), pp. 159-168. [157]
- : *Eunephthya* from middle Japan. *Ibid.*, 2 (1), pp. 27-40, pl. 1. [167]
- : 南部沖産異尾類 (紀州南部沖底曳採集品記録, 第 V 報) [Anomurans dredged from off Minabe (Record of Collections dredged from off Minabe, Prov. Kii, V).] 南紀生物 [Nanki Seibutu], 2 (3-4), pp. 149-151. (Mimeographed) (57)
- : 紀伊沿海生物相の調査について [On the biological survey of the marine fauna and flora in the environs of Kii.] *Ibid.*, 3 (1), pp. 1-8. (Mimeographed) (61)
- : 南部沖底曳魚類目録 (紀州南部沖底曳採集品記録, 第 VI 報) [List of offshore bottom-fishes off Minabe (Record of collections dredged from off Minabe, Prov. Kii, VI).] *Ibid.*, 3 (2-3), pp. 69-76.
- : 海への教室 [School-room on the seashore.] 187 pp. 文祥堂 [Bunsyôdô Book Co.], Osaka.

YAMAZI, Isamu: Plankton investigation in inlet waters along the coast of Japan. II. The plankton of Hakodate Harbour and Yoichi Inlet in Hokkaido. *Publ. Seto Mar. Biol. Lab.*, 1 (4), pp. 185-194. [160]

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Ficidae

No. 19

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黒田 徳米・波部 忠重

Ficidae in Japan

by

Tokubei KURODA and Tadashige HABE

Family Ficidae ビワガヒ科

Genus *Ficus* Roeding 1798 ビワガヒ屬

- 1798 *Ficus* Roeding, Mus. Bolten., p. 148.
- 1799 *Pyrula* Lamarck, Mem. Soc. Hist. Nat. Paris, 1, p. 73.
- 1810 *Pirula* Montfort, Conchyl. Syst., 2, p. 486.
- 1826 *Otus* Risso, Hist. Nat. L'Europe Méridionale, 1, p. 122.
- 1840 *Ficula* Swainson, Treat. Malac., p. 307.
- 1847 *Sycotylus* Gray, Proc. Zool. Soc. London, 15, p. 135.

Type species: *Ficus variegata* Roeding (= *Murex ficus* Linné) (designated by Winckworth 1945).

Ficus ficus (Linné) イチヂクガヒ

Pl. 19, fig. 1.

- 1758 *Murex ficus* Linné, Syst. Nat., ed. 10th, p. 752.
- 1798 *Ficus communis* Roeding, Mus. Bolten., p. 148.
- 1798 *Ficus variegata* Roeding, l. c., p. 148.
- 1799 *Pyrula ficus* Lamarck, Mem. Soc. Hist. Nat. Paris, 1, p. 73.
- 1810 *Pirula ficus* Montfort, Conchyl. Syst., 2, p. 487.
- 1829 *Pyrula ficus* Schubert et Wagner, Neues Syst. Conch. Cab., 12, p. 96.
- 1840 *Pyrula ficus* Kiener, Icon. Coq. Viv. *Pyrula*, p. 30.
- 1847 *Ficula laevigata* A. Adams et Reeve, Voy. Samarang, Moll., p. 39, pl. 9, fig. 4.
- 1850 *Ficula laevigata* Reeve, Conch. Icon., sp. 4.
- 1852 *Sycotylus ficus* H. et A. Adams, Gen. Rec. Moll., 1, p. 198, pl. 21, fig. 1.
- 1880 *Ficula ficus* Sowerby, Thes. Conch., 4, p. 109, pl. 423, fig. 4.
- 1881 *Ficula ficus* Kobelt, Syst. Conch. Cab., 3, (3b), p. 8, pl. 1, figs. 2, 3; pl. 24, figs. 6, 7.
- 1885 *Pyrula ficus* Tryon, Man. Conch., 7, p. 266, pl. 5, fig. 29; pl. 6, fig. 36.
- 1929 *Pirula ficus* Thiele, Handb. syst. Weicht., 1, p. 286, fig. 308.
- 1939 *Pirula ficus* Bayer, Zool. Mededeel., 21, p. 371.

Plate 19. Ficidae



Fig. 1. *Ficus ficus* (Linné) イチヂクガヒ. 2. *Ficus subintermedius* (d'Orbigny) ビワガヒ. 3. *Ficus gracilis* (Sowerby) オホビワガヒ. 4, 5. *Ficus filiosus* (Sowerby) イシバシビワガヒ.

1941 *Ficus ficus* Kuroda, Mem. Fac. Sci. Agr. Taihoku Imp. Univ., 22 (4), p. 107, pl. 1, fig. 16.

1951 *Ficus ficus* Is. Taki, Hirase's Handb. Illust. Shells, pl. 98, fig. 8.

Length 57.8 mm., breadth 34.3 mm. (figured specimen collected from Zamboanga, Mindanao, Philippines by Y. Yamamura).

Type locality: —

Distribution: Indo-Pacific regions; Formosa.

Ficus subintermedius (d'Orbigny) ビワガヒ

Pl. 19, fig. 2.

1822 *Pyrula ficoides* Lamarck, Anim. s. Vert., 7, p. 142 (non Brocchi 1814)

1840 *Pyrula ficoides* Kiener, Icon. Coq. Viv. *Pyrula*, p. 29.

1847 *Ficula reticulata* Reeve, Conch. Icon., sp. 1 (non Lamarck 1822)

1847 *Ficula intermedia* Sisonda, Synopsis meth. anim. invert. Pedem., 2nd, p. 37 (non Mellville 1843).

1852 *Pyrula subintermedia* d'Orbigny, Prod. Paléontol., 3, p. 173.

1859 *Ficus ficoides* Chenu, Man. de Conchyl., 1, p. 211, fig. 1150.

1880 *Ficula decussata* Sowerby, Thes. Conch., 4, p. 110, pl. 423, figs. 1, 3, (not of 2) (non Wood 1828)

1881 *Ficula reticulata* Kobelt, Syst. Conch. Cab., 3 (3b), p. 7, pl. 19, figs. 5, 6.

1885 *Pyrula reticulata* Tryon, Man. Conch., 7, p. 235, pl. 5, fig. 28.

1894 *Pyrula ficoides* Smith, Jour. of Malac., 3, p. 67.

1901 *Pyrula reticulata* Uchiyama, Zool. Mag. (Japan), 13, p. 274, pl. 17, fig. 13.

1914 *Ficus ficoides* Y. Hirase, Illust. Thousand Shells, 1, pl. 14, fig. 58.

1939 *Pyrula subintermedia* Bayer, Zool. Mededeel., 21, p. 379.

1941 *Ficus ficoides* Hatai, Rec. Mar. Shell Moll., pt. 1, p. 127, pl. 17, figs. 19, 20.

1947 *Ficus subintermedius* Kuroda, Illust. Encycl. Fauna Japan (rev. ed.), p. 1122, fig. 3185.

1951 *Ficus subintermedius* Is. Taki, Hirase's Handb. Illust. Shells, pl. 98, fig. 9.

Length 74.1 mm., breadth 40.1 mm. (figured specimen collected from Awaji Island, Hyogo Pref., Honshu, deposited in the Zoological Institute of Kyoto University).

Type locality: Indian Ocean?

Distribution: Indo-Pacific regions: Ryukyus; Kyushu; Shikoku and Honshu.

Ficus gracilis (Sowerby) オホビワガヒ

Pl. 19, fig. 3.

1825 *Pyrula gracilis* Sowerby, Cat. Tankerville, p. 62, App. p. 17.

1839 *Pyrula elongata* Gray, Zool. Bæchey's Voy. Moll., p. 115 (non Lamarck 1822)

1840 *Pyrula dussumieri* Kiener, Coq. Icon. Viv. *Pyrula*, p. 25, pl. 2.

1847 *Ficula dussumieri* Reeve, Conch. Icon., sp. 2.

1852 *Sycotylus dussumieri* H. et A. Adams, Gen. Rec. Moll., 1, p. 198, pl. 21, fig. 1a.

1880 *Ficula dussumieri* Sowerby, Thes. Conch., 4, p. 110, pl. 423, fig. 5.

1881 *Ficula dussumieri* Kobelt, Syst. Conch. Cab., 3 (3b), p. 10, pl. 1, fig. 1.

1885 *Pyrula dussumieri* Tryon, Man. Conch., 7, p. 266, pl. 5, fig. 30.

1894 *Pirula gracilis* Smith, Jour. of Malac., 3, p. 67.

1915 *Ficus dussumieri* Y. Hirase, Illust. Thousand Shells, 2, pl. 34, fig. 160.

1939 *Pirula dussumieri* Bayer, Zool. Mededeel., 21, p. 369.

Length 129.0 mm., breadth 61.8 mm. (figured specimen collected from Amami Oshima, deposited in the Zoological Institute of Kyoto University).

Type locality:—

Distribution: Indo-Pacific regions: Amami Islands; Shikoku, and Wakayama Pref., Honshu.

Ficus filusus (Sowerby) イシバシビワガヒ

Pl. 19, figs. 4, 5.

1892 *Pyrula filosa* Sowerby, Conchologist, 2, p. 74.

1894 *Pirula filosa* Smith, Jour. of Malac., 3, p. 69.

1942 *Ficus filusus* Yen, Proc. Malac. Soc. London, 24, p. 218, pl. 19, fig. 116.

Length 83.3 mm., breadth 48.5 mm. (figured specimen collected from Tosa Bay, Shikoku by A. Teramachi).

Type locality: Hongkong.

Distribution: China; Tosa Bay, Shikoku and off Wakayama Pref., Honshu.

Erratum

In No. 3 of this series (p. 19), the writer has wrongly described as *Bullina lineata* has no operculum. But the further investigation with another specimen he has later been convinced that the species provided with a distinct operculum which is corneous with paucispiral whorls as suggested by G.F. Angas in 1869. Thus the description (16th line) may be read as:.....“which has an operculum on.....”.

(Tadashige Habe)

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Plankton Investigation in Inlet Waters Along the
Coast of Japan

vi. The Plankton of Nanao Bay

(With 11 Text figures)

Isamu YAMAZI

日本海区水産研究所創立三周年記念論文集別刷

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SETO MARINE BIOLOGICAL LABORATORY

(Sirahama, Wakayama-ken, Japan)

Contribution No. 111

Plankton Investigation in Inlet Waters Along the Coast of Japan

VI. The Plankton of Nanao Bay *

(With 11 Text figures)

Isamu YAMAZI

Seto Marine Biological Laboratory, Sirahama, Wakayama-ken

Introduction

From the 4th to 6th of September, 1947 Prof. D. MIYADI of the Kyoto University and his co-workers carried out an extensive oceanographical survey in Nanao Bay with the object of investigating the productivity of the bay in connection with the sea conditions and of the re-examination of benthic communities. As a part of these investigations hydrological and planktological observations were made at each station in the bay. These stations are shown in Fig. 1 and given the number as in Miyadi and Masui's previous paper (1942, P. 1, Fig. 1). In the following I propose to present the planktological data obtained during this survey and to consider the distribution of plankton in correlation with the environmental (topographical and hydrological) factors.

The surface water was drawn up with a bucket at each station and 10 liters of water was filtered with a small net stretched with no. 20 silk gauze. The rough settling volume of each plankton sample thus collected was measured by the ordinary method. Other methods of hydrological observation and examination are referred to Yamazi (1950).

I am indebted much to Prof. D. Miyadi for his kind guidance and encouragement during this survey. I also wish to acknowledge with thanks their kind assistances given by my company during the survey and by members of the Nanao Branch of the Fisheries Experimental Station of the Ministry of Agriculture and Forestry (Japan Sea Regional Fisheries Research Laboratory at present). This investigation was supported partly by a grant from the Ministry of Education for scientific researches.

Topographical and Hydrological Conditions

Nanao Bay (Fig. 1) is a large indentation situated on the eastern coast of Noto Peninsula and facing towards Toyama Bay. It embraces a large island, Noto Sima, in its central part and by which the bay is divided into three parts, Northern, Southern and Western baylets. The Northern and Southern baylets are connected with Toyama Bay each through a channel, respectively Oguti (it means large mouth, 2.4 km in width) and Koguti (it means small mouth,

* This is the sixth of a series of papers designed to present planktological surveys made in various inlets or bays along the coast of Japan. The preceding papers have been published in "Publications of the Seto Marine Biological Laboratory" (See References)

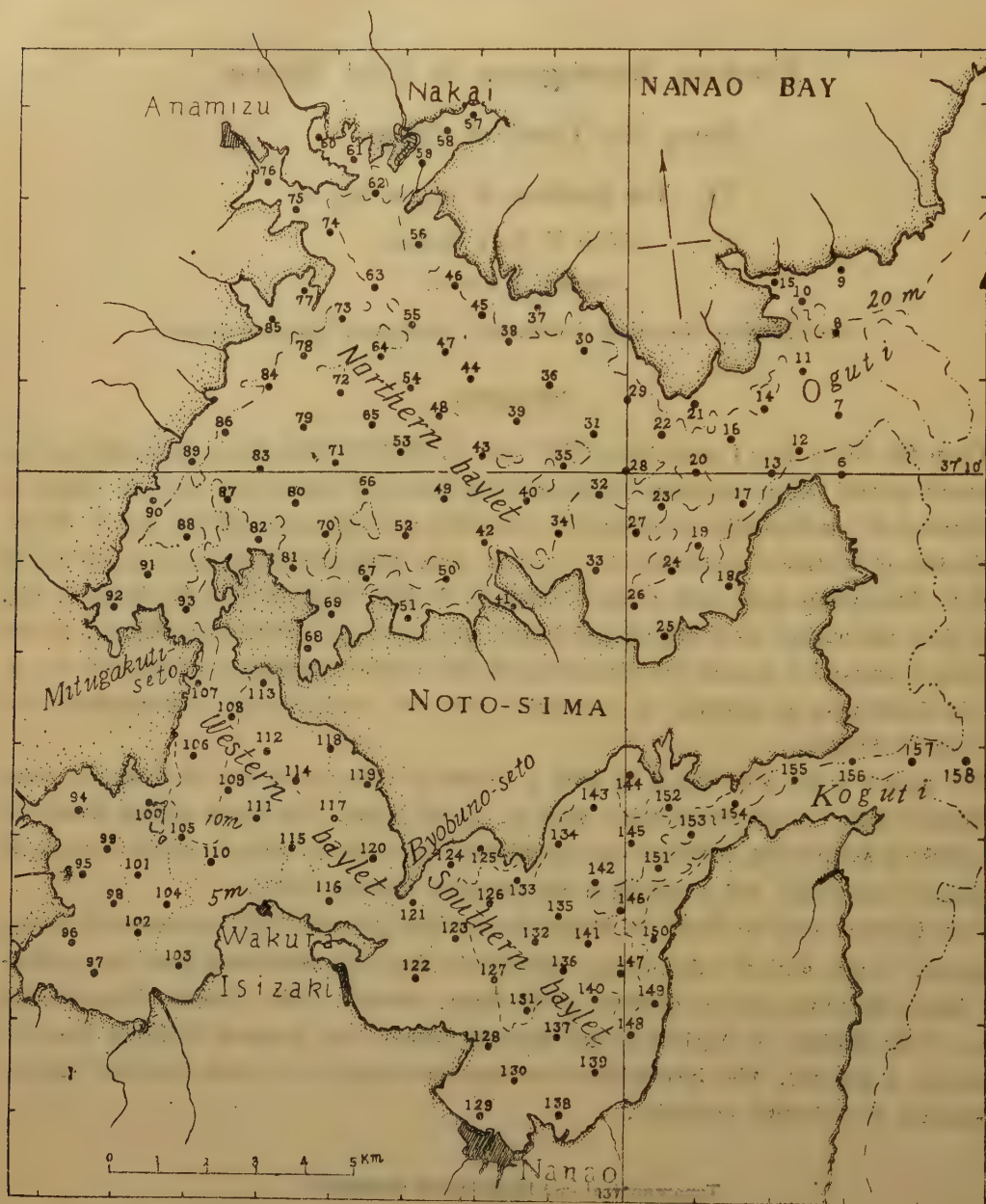


Fig. 1. Map of Nanao Bay, showing stations and isobaths.

0.8 km in width), and also with the Western baylet, the inner most part of the bay, each through a narrow channel, respectively Mitugakuti-seto and Byobuno-seto. The Northern baylet is the largest and deepest among the three; its central part is 20—40m deep, while the mouth is deeper than 50m. The western baylet is the smallest and shallowest, less than 10m in depth. Several rivers pour into the Western baylet along the western coast, where the bottom is covered densely with *Zostera marina*; the southwest corner is utilized as an oyster farming ground.

Table 1. Hydrological conditions of Nanao Bay.

Station	Depth (m)	Water temp. (°C)	Salinity (‰)	Oxygen		Trans- parency (m)	Water color (No.)	Mud temp. (°C)	Character of texture
				cc/L	%				
16	0	28.0	32.52	4.58	97	27	2	25.8	Sand
	5	27.7	32.53	4.69	98				
	15	27.7	32.25	4.44	93				
	25	27.5	32.52	4.55	95				
	35	27.1	32.54	4.38	91				
	45	25.5	32.94	3.08	62				
48	0	28.0	32.30	4.62	97	24	2	26.0	Sand
	5	27.7	32.52	4.59	93				
	15	27.7	32.05	4.52	94				
	25	27.9	32.52	5.08	106				
62	0	28.1	32.25	4.56	96	15	2—3	26.5	Mud
	5	28.0	32.43	4.57	96				
	15	27.9	32.48	5.38	113				
	25	27.9	32.73	3.98	84				
93	0	28.3	32.25	4.66	98	11.	5	27.2	Mud
	5	28.0	32.25	4.99	105				
	15	28.1	32.34	4.65	98				
110	0	27.9	31.72	4.30	90	3	6	27.5	Mud
	5	27.8	31.81	4.04	86				
114	0	27.7	32.28	4.46	94	3	6	27.2	Mud
	5	27.5	32.32	4.79	92				
121	0	27.9	31.58	4.79	100	2.4	8	28.0	Fine sand
	5	27.3	31.69	4.68	97				
141	0	28.7	31.99	4.62	98	3.9	7	28.0	Mud
	5	27.7	32.01	4.53	95				
156	0	28.0	31.92	4.51	95	6.2	5	27.2	Mud
	5	27.6	32.24	4.36	91				
158	0	28.0	31.84	4.57	95	26.5	2	27.0	Fine sand
	10	27.6	32.52	4.71	98				
	35	27.6	32.54	4.54	95				

The temperature transparency and water color were measured at 109 stations. The salinity and dissolved oxygen contents were measured at 10 stations (Table 1).

The surface temperature (Fig. 2) varies from 27.6 to 28.5°C, being lower in the Western and Southern baylets than in the Northern baylet. On the 10m layer of the Northern baylet, it is 27.6—28.2°C, a little higher in the southern area and the northern inlets than in the northern area and the mouth. The vertical distribution of temperature and Salinity is shown in Table 1.

The Salinity on each layer is higher, measuring 32.21—32.9%, in the Northern baylet than in the Western and Southern baylets; namely 31.7—32.3% in the former and 31.5—32.5% in the latter.

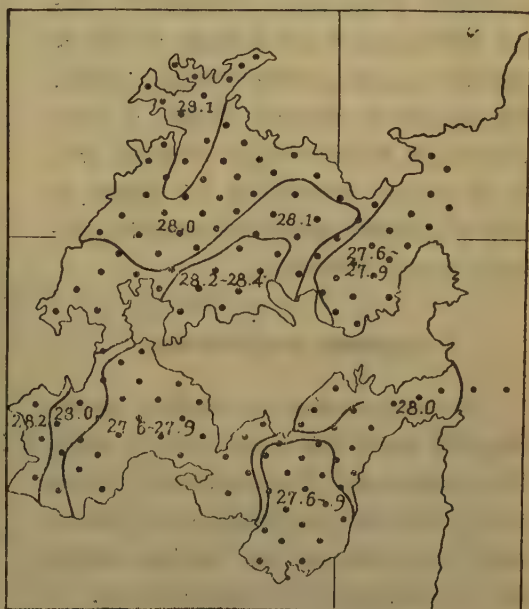


Fig. 2. Water temperature ($^{\circ}\text{C}$) of the surface layer.

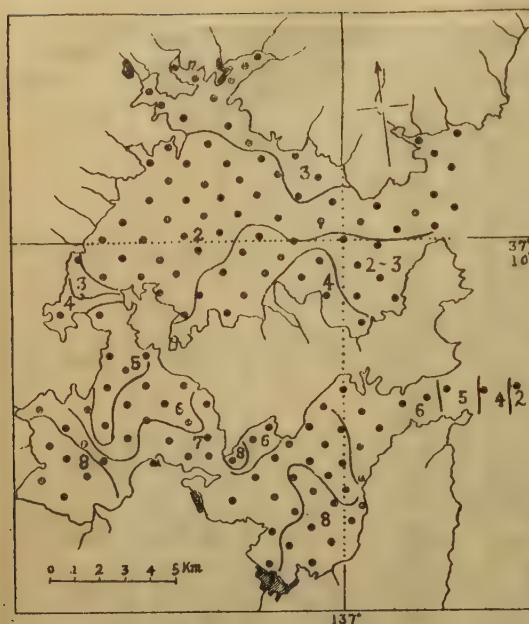


Fig. 3. Distribution of water-color.



Fig. 4. Distribution of transparency.

The transparency (Fig. 4) is fur larger in the Northern baylet, 15–25m, than in the Western and Southern baylets, 3–5m. The water color (Fig. 3) is characterized by the high values of Forel's scale nos. 6–8 in the Western and Southern baylets.

The horizontal and vertical distributions of dissolved oxygen content are shown in Tabl 1. From series of samples no marked difference is found as to the volume of dissolved oxygen and the saturation degree. The amount of dissolved oxygen is minimum in the Western baylet, although even in the bottom stratum of this baylet as well as Southern baylet, the saturation degree is greater than 90%.

Composition of the Plankton

The total number of plankton species identified during this survey is 85, of which 48 are plants and 37 are animals. It varies greatly according to the baylets, the largest value is recorded in the Northern baylet and the smallest in the Western baylet.



Fig 5. Settling volumes (cc) of plankton per 10 liters.

A...1–1.5cc ; B...0.5–0.9cc ; C...0.3–0.4cc ;
D...0.06–0.2cc ; E...<0.05cc

Quantitative Analysis of Plankton

The plankton was collected at 60 stations in the Northern baylet, 21 stations in the Southern and 24 stations in the Western baylet. The settling volume of plankton is largest in the eastern half of the Southern baylet, and smallest in the Western baylet. The total number of individuals, cells of colonies is smallest in the Northern baylet, excepting in inlets on the northern and western coasts. The largest number is 10 thousands per 10 liters; this value is measured near Koguti-Seto, the entrance to the Southern baylet (Fig. 5).

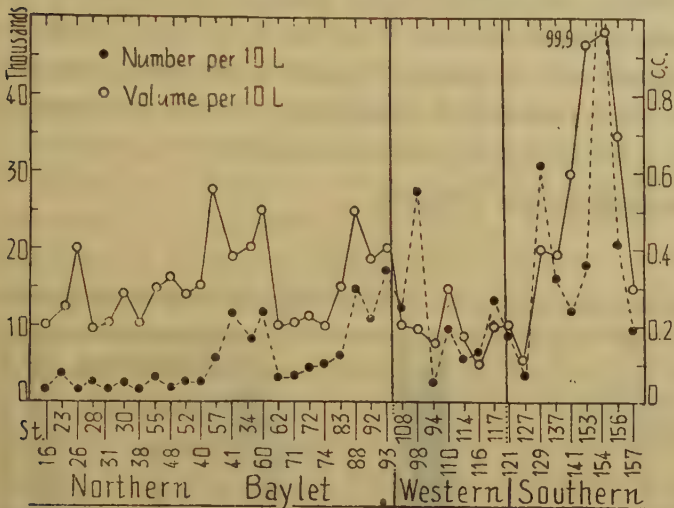


Fig. 6. The relation between the settling volume and the number of individuals, cells or colonies per 10 liters.

The relation between the settling volume (V) and the population number (N) per 10 liters is projected graphically in Fig. 6. V and N lines for stations in the Northern baylet are nearly parallel to each other, while they are quite different in configuration for stations in the Southern and Western baylets. This is clearly due to the quantitative and qualitative differences in zoo- and phytoplankton in various parts of the bay. The densest population of zooplankton is found in the Southern baylet and in northern inlets of the Northern baylet, where the individual number of plankton animals reaches 4,000—5,000 per 10 liters, while the smallest in the central part of the northern baylet,

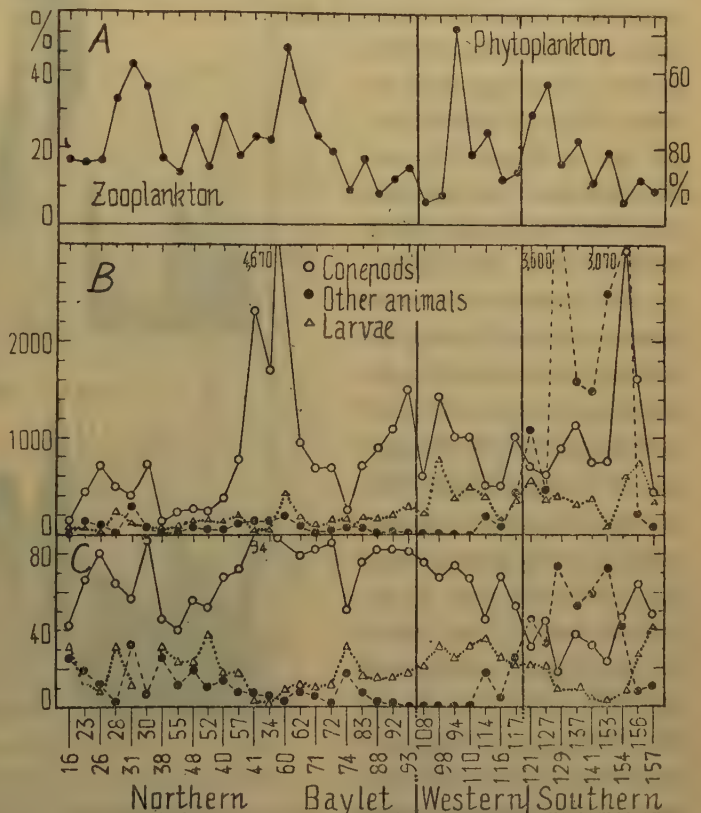


Fig. 7. A. Ratio between zoo- and phyto-plankton.
B. population of zoo-plankton per 10 liters.
C. percentage composition of zoo-plankton.

where it is 200–1,000 per 10 liters. The numerical percentage of zooplankton to the total plankton ($Z/N \times 100$) is relatively large throughout the whole samples. It is 10–40% in the Northern baylet, 5–50% in the Western and 3–35% in the Southern baylet (Fig. 7, A). Phytoplankton is very scarce through the whole stations. It is only 80 thousands of cells or colonies per 10 liters even at the stations near the channel “Koguti” where phytoplankton is observed most abundantly. The numerical percentage of phytoplankton to the total plankton ($P/N \times 100$) is smaller than that of the hitherto surveyed bays or inlets.

Qualitative Analysis of Plankton

Zooplankton :

The main component of zooplankton is copepods as shown in Fig. 7, B and C, its percentage to the total animal plankton being 40–90%. Other animal groups, such as Protozoa, Copelata, Chaetognatha, Mollusca etc., are represented by 2–70%. The larval forms, comprising those of molluscs, polychaetes, copepods, echinoderms etc., are represented by 5–40%. The important representatives are copepod nauplii and polychaete larvae, then followed by ophiopluteus. The larval composition differs much in three baylets.

The copepods are more abundant in the Western and Southern baylets and in the northern inlets of the Northern baylet than in the central area of the Northern baylet. The percentage, however, is higher in the Northern and Western baylets than in the Southern baylet. This phenomenon is due to existence of abundant other animals else than copepods, including larval forms, in the former two baylets. The copepods varies in number according to stations, while other animals and

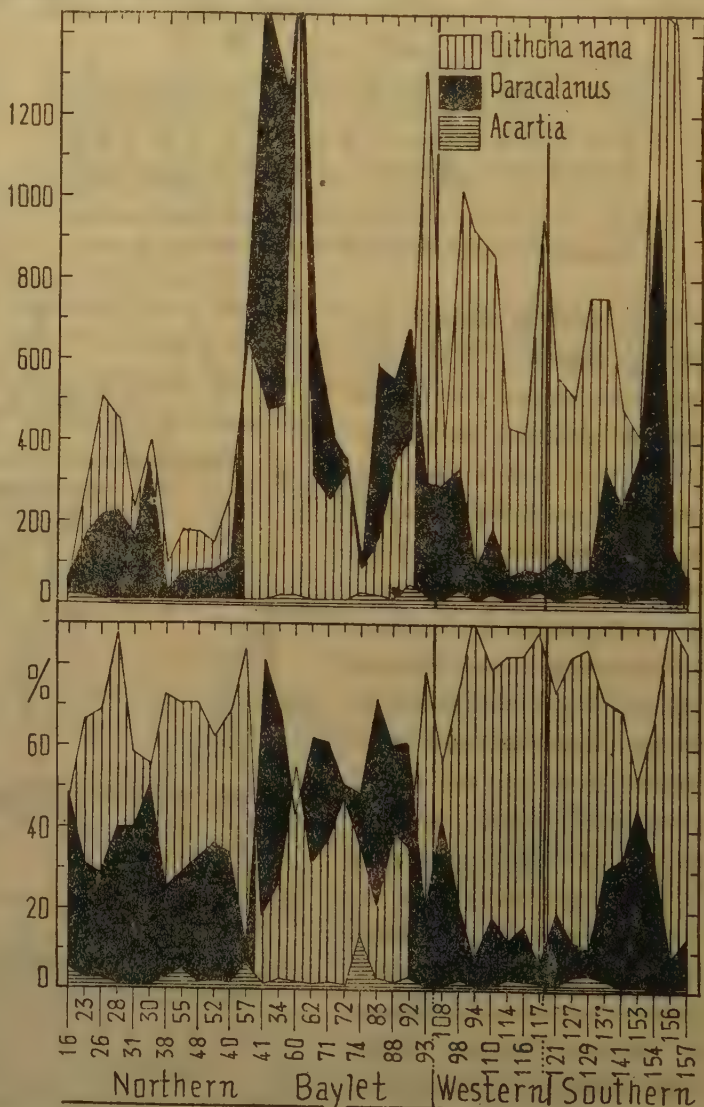


Fig. 8. Number of important copepods (above) and their percentage compositions (below).

larval forms are distributed rather uniformly, except in the Southern baylet.

Copepods : *Oithona nana* is predominant in number in the Western and Southern baylets and in the northern inlets of the Northern baylet as shown in Fig. 8. It occupies more than 80% of the total copepods in number, excepting in the inlets of Northern baylet, where percentage decreases to less than 40% owing to the large population of *Paracalanus parvus*. The individual number is the smallest in the eastern half of the Northern baylet, even where the percentage is relatively large being more than 50%.

Paracalanus parvus is also widely distributed. It is abundant in the northern inlets and the western half of the Northern baylet, where it occupies more than 50% of the total copepods in number. It decreases in both number and percentage towards the eastern half of the Northern baylet and in other baylets.

Acartia clausi and *A. spinicauda* occur very sparsely, although they increased somewhat in number in the Southern and Western baylets. *Tortanus forceipatus* is one of a certain importance in the Western and Southern baylets, though it is represented by a very small number as a whole. In the Northern baylet no *Tortanus* is found at all. The oceanic or coastal water copepods : (*Calanus vulgaris*, *Calocalanus pavo*, *Setella gracilis* and *Oithona similis*, *Oithona plumifera*, *Microsetella norvegica*, *Microsetella rosea*, *Tenora discaudata*, *Oncaea venusta*, *Oncaea media* and *Corycaeus crassiusculus*) occur very sparsely in the Northern baylet. *Euterpæ acutifrons* and *Centropages abdominalis* are widely distributed in a small number.

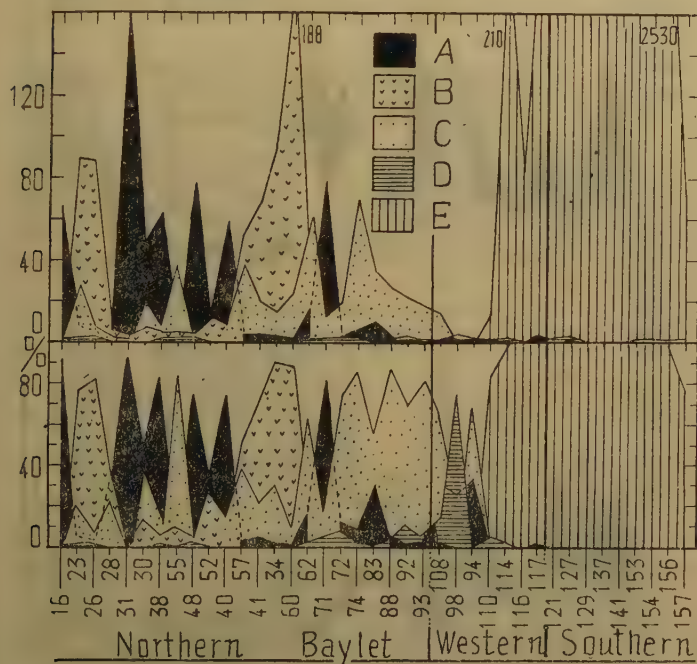


Fig. 9. Number of important zooplankters else than copepods and their percentage compositions (each per 10 liters).

A. *Creceis acicula* : B. *Fritillaria haplostoma* :
C. *Oikopleura dioica* and *Oikopleura longicauda* ;
D. *Sagitta delicata* : E. *Dictyocha fibula*.

Other animals : The

main components of other animals are shown in Fig. 9.

The eastern half of the Northern baylet is characterized by the abundance of oceanic forms, such as a pteropod *Creceis acicula* and a copelata *Fritillaria haplostoma*. In the western half and northern inlets of the same baylet, two copelats *Oikopleura dioica* and *Fritillaria haplostoma* are particularly abundant. In the Western baylet, however, these species, which are found very commonly in the Northern baylet, are negligible in number and are replaced by a silicoflagellate *Dictyocha fibula* which is abundant also in the Southern baylet. The Chaetognath *Sagitta delicata* is distributed very sparsely.

Other zooplankters are as follows: (Table 2)

(Table 2)

Species	Northern baylet	Southern baylet	Western baylet
<i>Tintinnopsis aperta</i>		+	+
<i>Tintinnopsis cylindrus</i>		+	+
<i>Tintinnopsis perminatus</i>		+	+
<i>Hydromedusae</i> sp.	+	+	+
<i>Synchaeta</i> sp.		+	+
<i>Evadne noronhai</i>	+	+	+
<i>Penilia schmackeri</i>	+	+	+
<i>Oikopleura longicauda</i>	+		
<i>Oikopleura fusiformis</i>	+		
<i>Globigerina</i> spp.	+		
Radiolarians	+		

Larval forms : Nauplii of copepods, chiefly of *Oithona nana*, are richer in the Western and Southern baylets than in the Northern baylet. Those of *Paracalanus parvus* are found abundantly in the western half of the Northern baylet.

Polychaeta larvae, *Ophiopluteus*, *Echinopluteus* and *Auricularian* are also numerous. The former two occur in the Northern baylet, while the latter two in the mouth of the Southern baylet. Other forms such as gastropod and pelecypod veligers, appendicularian larvae of *Ascidian*, zoëae and fish eggs and fry occur in a small number in the Northern baylet.

Phytoplankton :

The main components of the phytoplankton are shown in Fig. 10. Of these *Chaetoceros coarctatus* and *Rhizosolenia styliformis* are the most characteristic ones in the Northern baylet. On the contrary, dinoflagellates, such as

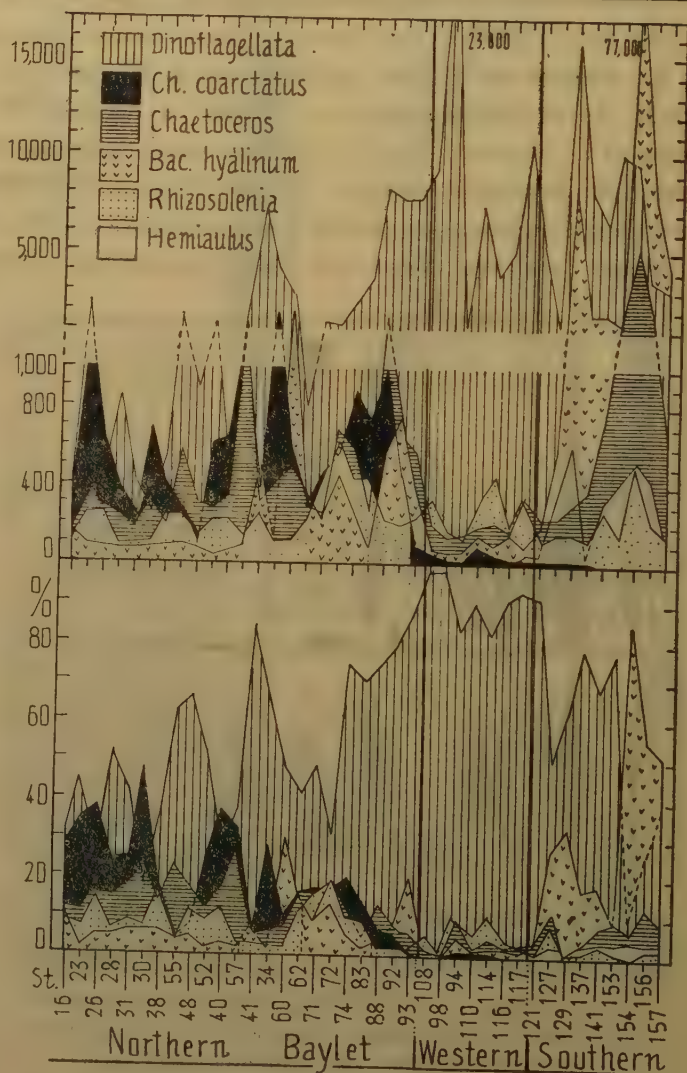


Fig. 10. Cell or colony number of important phytoplankton genera (above) and their percentage composition (below).

Ceratium tripas, *Cer. trichoceros*, *Cer. fusus* and *Cer. furca* are found predominantly in the Western baylet, but merely in a small number. *Pyrophacus horologicum* is found mainly in the Northern baylet. All these oceanic species seem to be carried at first into the Northern baylet from Toyama Bay. Some of them have grown to a large population in the Western and Southern baylets where some conditions have favoured their propagation, while others are merely remaining there without any propagation.

Diatoms : *Bacteriastrum hyalinum*, *Chaetoceros affinis*, *Ch. laciniosus*, *Ch. didymus* var. *anglica* and *Ch. didymus* are abundant near the entrance to the Southern baylet. The diatoms of the same composition are found also in other parts of the bay, although they are found merely there in a small number. *Rhizosolenia acuminata* and *Rh. hebetata* are observed at all stations, mostly in a small number, but they occur much abundantly in the inner part of the Northern baylet and the mouth of the Southern baylet. As a whole, the phytoplankters are fewer in the Northern baylet than in the other baylets. Other plants found during this survey are as follows. (Table 3)

(Table 3)

Species	Northern baylet	Southern baylet	Western baylet
Diatoms			
<i>Chaetoceros furca</i>	+		
<i>Ch. densus</i>	+		
<i>Ch. affinis</i>	+	+	+
<i>Ch. brevis</i>	+	+	+
<i>Ch. decipiens</i>	+	+	+
<i>Ch. oureisetus</i>	+		+
<i>Ch. atlanticus</i>	+		
<i>Ditylimum sol</i>	+		+
<i>Hemiaulus Hauckii</i>		+	+
<i>Rhophalia sinensis</i>	+	+	+
<i>Biddulphia longicruris</i> var. <i>Japonica</i>			+
<i>Rhizosolenia robusta</i>	+		
<i>Rh. alata</i> form <i>gracilima</i>	+		
<i>Rh. alata</i> form <i>indica</i>	+		+
<i>Rh. Stolterfothii</i>		+	+
<i>Asterionella Japonica</i>	+	+	+
<i>Pleurosigma affine</i>			+
<i>Pleurosigma intermedium</i>		+	+
<i>Pleurosigma</i> sp. <i>n.</i>		+	+
<i>Nitzschia longissima</i>		+	+
<i>Nitzschia seriata</i>	+	+	+
<i>Thalassionema nitzschioides</i>		+	+
<i>Thalassiothrix Frauenfeldii</i>	+	+	+
<i>Eucampia zoeplax</i>	+		
<i>Paralia sulcata</i>			+
<i>Skeletonema costatum</i>		+	+
<i>Stephanopyxis palmeriana</i>	+		+
<i>Actinopterychia unipulvata</i>	+	+	+
<i>Coscinodiscus</i> spp.	+	+	+

Dinoflagellata			
<i>Prorocentrum micans</i>		+	+
<i>Dinophysis ovum</i>		+	+
<i>Peridinium oceanicum</i> var. <i>oblongum</i>		+	+
<i>Ceratium deflexum</i>	+	+	+
<i>Cer.</i> <i>pennatum</i>	+	+	+
<i>Cer.</i> <i>macroceros</i>	+		
<i>Cer.</i> <i>masciliense</i>	+	+	

General Consideration on Regional Distribution

The differences in physiographical and hydrographical factors in three baylets of Nanao Bay are generally conspicuous and the contribute to the differentiation of the plankton communities, as well as the benthic communities. As is clearly deduced from the map of the bay shown in Fig. 1, the Northern baylet is largest in the area, depth and extent of the oceanic influx, while the Western baylet is least in those. The water of the Northern baylet is less stagnant and well aerated, while it is rather turbid and less saline in the Southern and Western baylets. These differences found in the three baylets must have a marked influence on the plankton composition observed in these baylets.

On the basis of the arrangement of some characteristic zooplankters as previously proposed by TOKIOKA (1951) and YAMAZI (1952,a,b,c), Nanao Bay may be divided in regard to plankton communities into the following well-defined ecological areas.

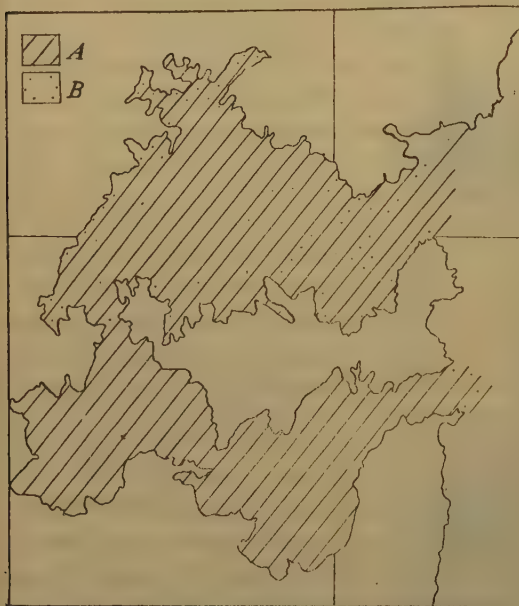


Fig. 11. Distributions of two dominant copepods.
A *Oithona nana* ; B *paracalanus parvus*.

1. Western baylet.

The community of this baylet is characterized by the predominance of *Oithona nana* in percentage composition. Besides, the nauplii of *Oithona nana*, a silicoflagellate *Dietyocha fibula* and dinoflagellates are very numerous. Other animals and diatoms are very poor. This baylet is very shallow ; the water is highly stagnant, colored yellowish brown and with smaller transparency especially towards the western half. Thus, the whole baylet may be classified as an *Oithona nana* area.

2. Southern baylet

This baylet is also occupied predominantly by *Oithona nana* and may be called as an *Oithona nana* area. However, in this baylet this copepod is associated with a large number of *Dietyocha fibula* and dinoflagel-

lates, besides a small number of *Paracalanus parvus*, *Acartia clausi* and *Tortanus forcipatus*. This baylet is deeper than the Western baylet, especially in the eastern half where the transparency is larger and the water color in Forel's scale is lower than in the western half as

well as in the Western baylet. The surface water of the baylet shows almost the same salinity as in the Western baylet. It seems, therefore, reasonable to assume that the plankton inhabiting in the inner part of the Western baylet may be carried in to the Southern baylet by a easterly current.

The area near Koguti-seto is occupied by dense neritic diatoms and also by *Bacteriastrum hyalinum* and *Chaetoceros* spp.. The population density of both zoo- and phytoplankters are greatest in this area than in any other parts of the bay.

3. Northern baylet.

The main region of the Northern baylet is characterized by the dominance of two copepods *Paracalanus parvus* and *Oithona nana* in percentage composition, and may be called as a *Paracalanus parvus*-*Oithona nana* area. *Paracalanus* attains 50–400 per 10 liters and *Oithona*-population 80–600. *Calanus pauper*, *Oithona similis* and other copepods are carried into there from the outside in a small number. Many oceanic animals and plants are also found at each station. The distribution of *Oithona nana* extends to the mouth of the baylet, Ōguti-seto and probably even further outwards. The population of plankton is smallest in these baylets, though the number of species is greatest.

The main part of the Northern baylet is influenced strongly by the influx of the open sea water. Consequently it is characterized by higher transparency, lower class of water color and higher salinity. The strong influx of the open sea water may be proved also from the distribution of plankton, as mentioned above.

The inlets of this baylet are occupied predominantly by *Paracalanus* and *Oithona*, the former less than ca. 3,000 and the latter about 2,000 per 10 liters, and associated by a large number of *Oikopleura* and *Fritillaria*.

References

- MIYADI, D. & MASUI, T., (1942): Studies on the benthic communities of Nanao-Wan. Jour. Oceano. Soc. of Japan. Vol. 2, No. 1. (In Japanese)
- YAMAZI, I., 1950, 1951: Plankton Investigation in Inlet Waters along the Coast of Japan. I, II. Publ. Seto Mar. Biol. Lab. Vol. 1, Nos. 3 and 4.
- _____, (1952), a b, c. Idem III, IV, V, Ibid., Vol. 2, No. 2
- TOKIOKA, T, YAMAZI, I. & HUSE, S., (1951): Studies on the pearl fishing ground of Ago Bay. V. Estimation of the hydrographical and hydrobiological Influences of Hukaya Channel upon Hunakosi baylet in Ago Bay. Seiri Seitai Kenkyu Gyoseki, No. 73. (In Japanese)

理學博士 黒田徳米監修
日 本 貝 類 圖 録
Illustrated Catalogue of Japanese Shells
Edited by Dr. Tokubei Kuroda

November 30, 1952

Atyidae

No. 20.

日 本 産 タ マ ゴ ガ ヒ 科

波 部 忠 重

Atyidae in Japan

by

Tadashige HABE

Family Atyidae タマゴガヒ科

Genus *Atys* Montfort 1810 タマゴガヒ属

1810 *Atys* Montfort, Conchyl. Syst., 2, p. 343.

1817 *Naucum* Schumacher, Essai Nouv. Syst. Vers. Test., pp. 79, 259.

Type species: *Atys cymbalum* Montfort (= *Bulla naucum* Linné) (monotypy)

Atys naucum (Linné) タマゴガヒ

Pl. 21, figs. 17, 18.

1758 *Bulla naucum* Linné, Syst. Nat., ed. 10, p. 726.

1791 *Bulla atys* Gmelin, Syst. Nat., ed. 13, p. 3424.

1810 *Atys cymbalum* Montfort, Conchyl. Syst., 2, p. 343.

1817 *Naucum striatulum* Schumacher, Essai Nouv. Vers. Test., pp. 79, 259.

1850 *Bulla (Atys) naucum* A. Adams, Thes. Conch., 2, p. 584, pl. 124, figs. 107-109.

1869 *Atys naucum* Sowerby, Conch. Icon., sp. 1.

1894 *Atys naucum* Pilsbry, Man. Conch., 15, p. 263, pl. 28, figs. 11-16.

1896 *Atys naucum* Kobelt, Conch. Cab., 1 (9) p. 13, pl. 2, figs. 13, 14.

1931 *Atys naucum* Thiele, Handb. syst. Weicht., 1 (2), p. 385, fig. 484.

1941 *Atys naucum* Hatai, Rec. Mar. Shells South Sea Islands, pt. 1, p. 159, pl. 2, figs. 2, 3.

1951 *Atys naucum* Is. Taki, Handb. Illust. Shells, pl. 118, fig. 13.

Length 24.2mm., breadth 16.1mm. (figured specimen collected from the Amami group by Dr. T. Kuroda).

Length 50.0mm., breadth 40.0mm. (figured specimen collected from the Philippines by Miss Y. Yamamura).

Type locality: Asia.

Distribution: Indo-Pacific region; Ryukyu and Amami groups.

Genus *Aliculastrum* Pilsbry 1896 カイコガヒ属

1831 *Alicula* Ehrenberg, Symb. Phys. Moll. sign. 1 (non Eichwald 1830).

1896 *Aliculastrum* Pilsbry, Man. Conch., 16, p. 237.

Type species: *Bulla cylindrica* Helbling (original designation).

Aliculastrum cylindricum (Helbling) カイコガヒ

Textfig. 1.

1779 *Bulla cylindrica* Helbling, Abh. Privat. Ges. Boehmen, 4, p. 122, pl. 2, figs. 30, 31.

1850 *Bulla* (*Atys*) *cylindrica* A. Adams, Thes. Conch., 2, p. 485, pl. 125, fig. 114.

1869 *Atys cylindrica* Sowerby, Conch. Icon., sp. 7.

1894 *Atys* (*Alicula*) *cylindrica* Pilsbry, Man. Conch., 15, p. 265, pl. 33, figs. 60-64.

1896 *Atys cylindrica* Kobelt, Conch. Cab., 1 (9), p. 16, pl. 2, figs. 15, 16.

1941 *Atys* (*Aliculastrum*) *cylindrica* Hatai, Rec. Mar. Shells South Sea Islands, pt. 1, pp. 48, 158, pl. 1, figs. 7, 8.

1947 *Atys* (*Aliculastrum*) *cylindrica* Kuroda, Illust. Encycl. Fauna Japan, (Rev. ed.), p. 1086, fig. 3077.

1951 *Atys cylindrica* Is. Taki, Handb. Illust. Shells, pl. 118, fig. 14.

Length 18.2mm., breadth 9.1mm. (examined specimen collected from Shimajiri, Okinawa main Island by Dr. T. Kuroda).

Type locality: unknown to the writer.

Distribution: Indo-Pacific region: Ryukyu and Amami groups; Kyushu and Honshu.

Genus *Limulatys* Iredale 1936 ホソタマゴガヒ属

1936 *Limulatys* Iredale, Rec. Austr. Mus., 19 (5), p. 328.

1936 *Tepidatys* Iredale, l. c., p. 239.

Type species: *Limulatys reliquus* Iredale (original designation)

Limulatys ooformis, sp. nov. ホソタマゴガヒ

Pl. 20, fig. 9.

Shell medium for the genus, thin, pellucid, ovate, somewhat truncated at the summit; spire involute; body whorl broadest at the middle and sculptured with about 15 spiral impressed striae at the upper and lower parts, but smooth towards the middle part; aperture long, and upper margin rises well above the concave vertex, and twisted; outer margin gently arched, and columellar margin thin, slightly twisted; umbilicus perforated and surrounded with the angular border.

Length 12.6mm., breadth 7.0mm. (figured type specimen collected from Wakayama Pref., Honshu by Mr. A. Teramachi).

Type locality: Wakayama Pref., Honshu.

Distribution: Kyushu; Shikoku and Honshu.

Remarks: This new species resembles and was erroneously identified by some authors as *Atys semistriata* Pease from Hawaii, but may be distinguished from the latter in having a more elongate shell, the middle part of which is the broadest.

Limulatys okamotoi, sp. nov. トツクリタマゴガヒ (新稱)

Pl. 20, fig. 13.

Shell medium in size, thin, semitranslucent, fusiform, tapering to both ends, and constricted below the vertex; vertex truncated and excavated at the centre, but not perforated; sculpture consists of spiral grooves on the both ends; the intervals between the grooves closely sculptured with rounded



Textfigs. 1. *Aliculastrum cylindricum* (Helbling) カイコガヒ, 2. *Bullacta exarata* (Philippi) ヒナギヌガヒ, 3. *Lathophthalmus smaragdinus* (Rüppell et Leuckart) テフテフミドリガヒ, 4. *Haloo rotundata* (A. Adams) ブドウガヒ, (1, 2 and 4 after Illust. Fauna Japan 1947; 3 after Baba 1936).

rib-striae near the ends, but smooth towards the central portion, forming a smooth zone; aperture long and narrow, uppermost margin pinched up into a narrow ridge at its extremity; outer margin moderately arcuate, columellar margin somewhat straight, bearing a weak fold at [the centre. Umbilicus perforated and bordered with an angular ridge.

Length 10.0mm., breadth 5.0mm. (figured type specimen collected by Mr. M. Okamoto).

Type locality: Hakata Bay, Kyushu.

Distribution: Hakata Bay and Akune, Kagoshima Pref., Kyushu.

Remarks: This new species resembles *Atys semitortuosa* Schepman, but

the Japanese species has a more elongate shell, the middle portion of which is broader and the summit is decidedly constricted below.

Limulatys constrictus, sp. nov. クビレタマゴガヒ (新稱)

Pl. 20, fig. 10.

This new form is closely allied to the preceding species in general features, but has a remarkably robust shell which is more strongly constricted below the vertex and the columellar margin is arcuately sinuous.

Length 7.0mm., breadth 4.5mm. (figured type specimen collected by the author).

Type locality: Kowa Bay, Mie Pref., Honshu.

Distribution: Kowa Bay, Mie Pref.; Uragami Bay, Wakayama Pref. and Obama Bay, Fukui Pref., Honshu.

Limulatys angustatus (Gould) ウスミドリタマゴガヒ (新稱)

Pl. 21, fig. 21.

1859 *Haminea angustata* Gould, Proc. Boston Soc. Nat. Hist., 7, p. 139.

Length 4.6mm., breadth 2.5mm. (figured specimen collected from Hakata Bay by Mr. M. Okamoto).

Type locality: Simoda, Izu Peninsula, Honshu.

Distribution: Kyushu and Honshu (Ago Bay; Kowa Bay and Hoza Bay, Mie Pref. and off Emi, Chiba Pref., Soyo-maru Station No. 4, 287m. in depth).

Remarks: The specimen figured under this name by Sowerby¹⁾ may not be identical with Gould's species.

Limulatys muscarius (Gould) ミドリタマゴガヒ (新稱)

Pl. 20, fig. 1.

1859 *Atys muscaria* Gould, Proc. Boston Soc. Nat. Hist., 7, p. 139.

1868 *Atys muscaria* Sowerby, Conch. Icon., sp. 5.

1894 *Atys muscaria* Pilsbry, Man. Conch., 15, p. 264, pl. 28, fig. 20.

1898 *Atys muscaria* Kobelt, Conch. Cab., 1 (9), p. 24, pl. 8, fig. 6.

1944 *Atys muscaria* Yen, Proc. California Acad. Sci., 23 (38), p. 578, pl. 51, figs. 40, 41.

Length 5.8mm., breadth 3.2mm. (figured specimen collected from Kakeromajima, Amami group, by Mr. R. Kawamura).

Type locality: China Seas.

Distribution: China Seas and Amami group.

1) Conch. Icon., sp. 32 (1868).

Limulatys (?) *scrobiculatus* (A. Adams)

1862 *Atys scrobiculata* A. Adams, Ann. Mag. Nat. Hist., (3), 9 (50), p. 158.

1893 *Atys scrobiculata* Pilsbry, Man. Conch., 15, p. 256.

Figure and measurement of shell were not given in the original description.

Type locality: Tobi-shima in the Japan Sea (25 fathoms in depth).

Genus *Nipponatys* Kuroda et Habe 1952 チャボダマガヒ属

1952 *Nipponatys* Kuroda et Habe, Check List Bibliogr. Rec. Mar. Moll. Japan, p. 72.

Type species: *Atys* (*Alicula*) *volvulina* A. Adams (original designation).

Remarks: This genus resembles *Volvulella* superficially, but has the ascending upper margin twisted and also the columellar margin weakly and obliquely truncated below.

Radular formula is 4. 1. 4. The rachidian is broad trapezoid in shape and marginal teeth are of horn-shape. Stomachal plates are of *Atys*-type.

Nipponatys volvulinus (A. Adams) チャボダマガヒ (新稱)

Pl. 20, fig. 5; pl. 21, fig. 27.

1862 *Alicula volvulina* A. Adams, Ann. Mag. Nat. Hist., (3), 9 (50), p. 159.

1894 *Atys* (*Alicula*) *volvulina* Pilsbry, Man. Conch., 15, p. 270.

Length 4.7mm., breadth 2.8mm. (figured specimen collected from Obama Bay, Fukui Pref., Honshu).

Type locality: Tsu-shima (26 fathoms in depth), between Kyushu and Korea.

Distribution: Kyushu (Imari Bay, Saga Pref.) and Honshu (Nanao Bay, Noto Peninsula; Obama Bay, Fukui Pref.; Maizuru Bay, Kyoto Pref.; Tanabe Bay, Wakayama Pref. and Ago Bay, Mie Pref.).

Genus *Diniatys* Iredale 1936 キバカイコガヒ属

1854 (September) *Dinia* H. et A. Adams, Gen. Rec. Moll., 2, p. 21 (non Walker 1854 (May)).

1936 *Diniatys* Iredale, Rec. Austr. Mus., 19 (5), p. 329.

Type species; *Bulla* (*Atys*) *dentifera* A. Adams (original designation).

Diniatys dentifer (A. Adams) キバカイコガヒ

Pl. 20, fig. 12.

1850 *Bulla* (*Atys*) *dentifera* A. Adams, Thes. Conch., 2, p. 588, pl. 125, fig. 124.

1868 *Atys dentifera* Sowerby, Conch. Icon., sp. 13.

1894 *Atys* (*Dinia*) *dentifera* Pilsbry, Man. Conch., 15, p. 276, pl. 27, fig. 81.

1896 *Atys* (*Dinia*) *dentifera* Kobelt, Conch. Cab., 1 (9), p. 27, pl. 8, fig. 15,

Length 6.7mm., breadth 4.2mm. (figured specimen collected from Tokunoshima, Amami group).

Type locality: Northern Australia.

Distribution: Indo-Pacific region; Ryukyu and Amami groups.

Diniatys monodonta (A. Adams) イツボンバカイコガヒ

Pl. 20, fig. 11.

1850 *Bulla* (*Atys*) *monodonta* A. Adams, Thes. Conch., 2, p. 588, pl. 125, fig. 123.

1868 *Atys monodonta* Sowerby, Conch. Icon., sp. 12.

1894 *Atys* (*Dinia*) *monodonta* Pilsbry, Man. Conch., 15, p. 276, pl. 28, fig. 17.

1896 *Atys* (*Dinia*) *monodonta* Kobelt, Conch. Cab., 1 (9), p. 28, pl. 8, fig. 16.

Length 5.3mm., breadth 3.0mm. (figured specimen collected from Kakeromajima, Amami group by Mr. R. Kawamura).

Type locality: Borneo.

Distribution: Borneo; Ryukyu and Amami groups.

Genus *Cylichnatys* Kuroda et Habe 1952 カミスヂカイコガヒダマン属

1952 *Cylichnatys* Kuroda et Habe, Check List Bibliogr. Rec. Mar. Moll. Japan, p. 51.

Type species: *Bullinella striata* Yamakawa (original designation)

Shell cylindrical ovate, weakly striated all over the surface; vertex shallowly concave, but not perforated; upper and columellar margins not twisted; umbilicus not present.

Radula formula 1. 1. 1. Rachidian small and marginal tooth on each side, long and tapering to the distal end and with many minute denticulations on the inner side. Stomachal plates are of *Atys*-type.

Cylichnatys striatus (Yamakawa) カミスヂカイコガヒダマン

Pl. 20, fig. 14; pl. 21, figs. 31, 32.

1911 *Bullinella striata* Yamakawa, Jour. Geol. Soc. Tokyo, 18, p. 51, pl. 11, figs. 3, 7, 38.

1920 *Cylichna yamakawai* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 39 (6), p. 28, pl. 1, fig. 7.

1939 *Cylichna yamakawai* Nomura, Jap. Jour. Geol. Geogr., 19 (1.2), p. 17, pl. 3, figs. 3a, b.

1939 *Cylichna asamusiensis* Nomura, l. c., p. 18, pl. 3, figs. 5a, b.

1939 *Cylichna kesenumaensis* Nomura, l. c., p. 18, pl. 3, figs. 4a, b.

Length 7.3mm., breadth 3.7mm. (figured specimen collected from Obama Bay, Fukui Pref., Honshu)

Type locality: Dokwanyama, Tokyo City (Pleistocene fossil)

Distribution: Honshu; Shikoku and Kyushu.

Genus *Mimatys* nov. ケシタマガヒ属

Type species: *Mimatys fukuokaensis* sp. nov. ケシタマガヒ (新稱)

(Pl. 20, fig. 2.)

Shell minute, white, solid, sphaerical in shape; spire involute; vertex has small and shallow concavity and is slightly perforated; surface sculptured with many punctate spiral grooves; aperture rather wide; columellar margin has a distinct fold above the middle; umbilicus decidedly perforated.

Length 2.0mm., breadth 1.3mm. (figured type specimen collected by Mr. M. Okamoto).

Type locality: Hakata Bay, Fukuoka Pref., Kyushu.

Remarks: This new genus resembles *Roxania*, but has a distinct fold on the columellar margin. The animal of this species is unknown.

Genus *Micratys* nov. ナンキンダマガヒ屬

Type species: *Micratys ovum* sp. nov. ナンキンダマガヒ (新稱) (Pl. 20, fig. 3)

Shell minute, thin, semitransparent, polished, sphaerical in shape; spire not appeared; vertex truncated and shallowly sunken and narrowly perforated in the centre; sculpture consists of spiral grooves at both ends, about two at the upper end and five on the lower third; aperture rather wide; the upper margin above the vertex is rather low and rounded; columellar margin straightened, without a fold; umbilicus perforated.

Length 2.0mm., breadth 1.6mm. (figured type specimen).

Type locality: Kowa Bay, Mie Pref., Honshu.

Remarks: *Atys palmarum* Hedley²⁾ from Australia is the closely allied one.

Subfamily Bullactinae ヒナギヌガヒ亞科

Genus *Bullacta* Bergh 1901 ヒナギヌガヒ屬

1901 *Bullacta* Bergh, Malak. Unter., 5, p. 292.

1924 *Atyscaphander* Annandale, Proc. Malac. Soc. London, 16, p. 34.

1933 *Sinohaminea* Tchang-Si, Jour. Sci. Nat. Univ. Shangtung, 1 (2), p. 371.

Type species: *Bulla cauria* Benson (= *Bullaea exarata* Philippi) (monotypy).

Bullacta exarata (Philippi) ヒナギヌガヒ

Textfig. 2.

1848 *Bullaea exarata* Philippi, Zeitschr. f. Malakozool., p. 141.

1850 *Bulla sinensis* A. Adams, Thes. Conch., 2, p. 582, pl. 104, fig. 98.

1856 *Bulla cauria* Benson, Jour. Asiatic Soc. Bengal, 24, p. 128.

1868 *Haminea sinensis* Sowerby, Conch. Icon., sp. 21.

1894 *Haminea exarata* Pilsbry, Man. Conch., 15, p. 362, pl. 40, fig. 97.

1895 *Philine cauria* Pilsbry, Man. Conch., 16, p. 9.

1896 *Scaphander cauria* Kobelt, Conch. Cab., 1 (9), p. 107, pl. 15, fig. 18.

2) Rec. Austr. Mus., 3 (3), p. 157, pl. 44, fig. 41 (1912).

- 1901 *Bullacta cauria* Bergh, Malak. Unters., 5, p. 292, pl. 22, figs. 31-39; pl. 23, figs. 1-8.
 1923 *Atyscaphander exarata* Annandale, Proc. Malac. Soc. London, 16, p. 34.
 1932 *Bullacta exarata* Kuroda, Venus, 3 (2), p. 113, textfigs. 1, 2.
 1933 *Sinohaminea tsangkonensis* Tchang-Si, Jour. Sci. Nat. Univ. Shangtung, 1 (2), p. 371.
 1934 *Bullacta exarata* Tchang-Si, Contrib. Inst. Zool. Nat. Acad. Peiping, 2 (2), p. 3, pls. 1-7.
 1947 *Bullacta exarata* Kuroda, Illust. Encycl. Fauna Japan (rev. ed.), p. 1086, fig. 3078.
 Length 13.6mm., breadth 9.8mm. (examined specimen collected from Korea).
 Type locality: Northern China.
 Distribuiton: China and Korea. (South and Western Coasts).

Subfamily Smaragdinellinae ミドリガヒ亜科

Genus *Smaragdinella* A. Adams 1848 ミドリガヒ屬

- 1848 *Smaragdinella* A. Adams, Voy. Samarang, App. Moll., 2, p. 475.
 1850 *Linteria* A. Adams, Thes. Conch., 2, pp. 558, 597.
 1850 *Glaucanella* Gray, Fig. Moll. Anim., 4, p. 95.
 Type species: *Bulla viridis* Quoy et Gaimard.

Smaragdinella calyculata (Broderip et Sowerby) ミドリガヒ

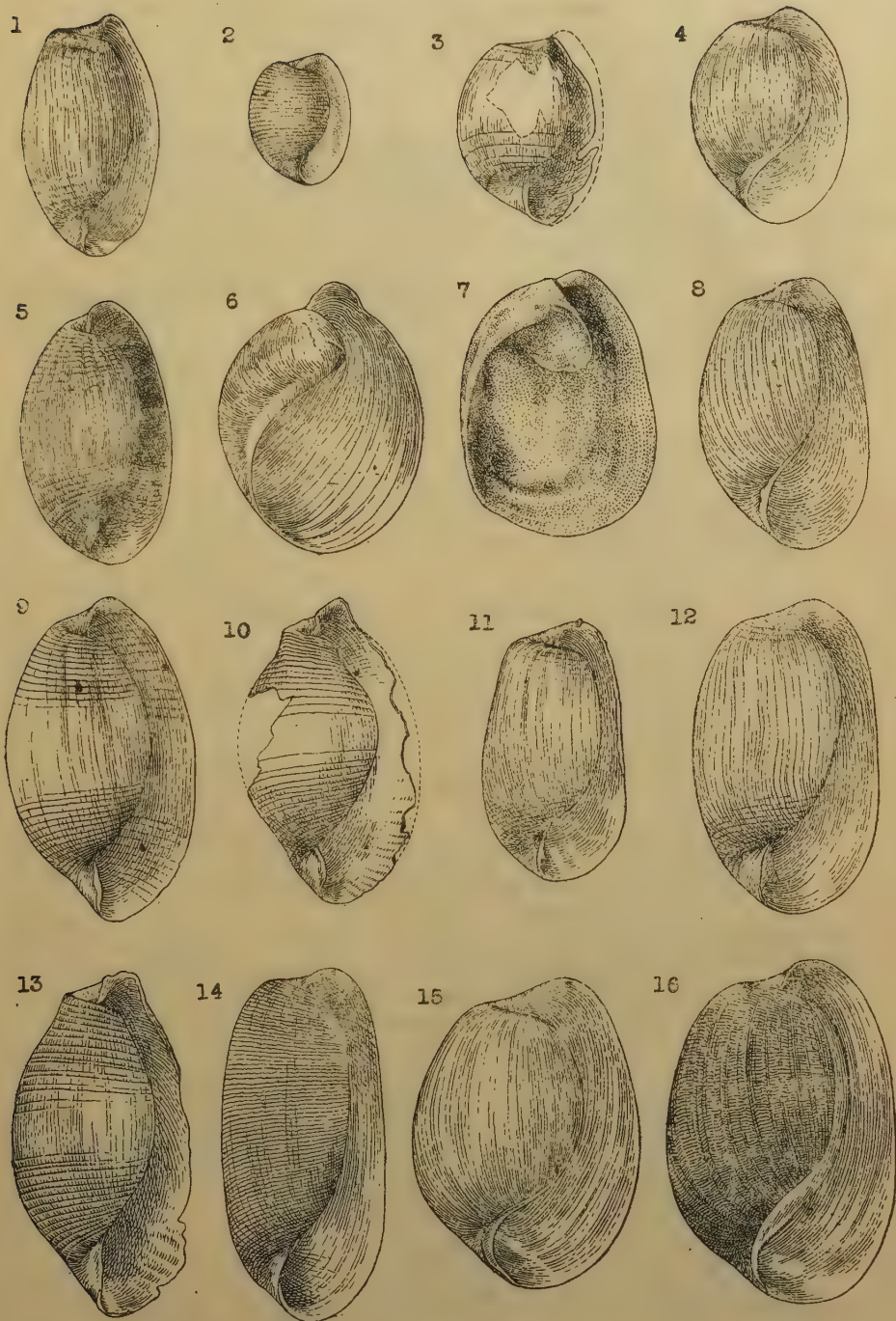
Pl. 20, fig. 7, pl. 21, fig. 26.

- 1829 *Bulla calyculata* Broderip et Sowerby, Zool. Jour., 4, p. 369.
 1833 *Bulla viridis* Quoy et Gaimard, Voy. Astrolabe, Zool., 2, p. 350.
 1850 *Bulla* (*Linteria*) *viridis* A. Adams, Thes. Conch., 2, p. 597, pl. 121, fig. 52.

Explanation of Plate 20. 第 20 圖版説明

- Figs. 1. *Limulatys muscarius* (Gould) ミドリタマゴガヒ, 5.8×3.2mm p. 140.
 2. *Mimatys fukuokaensis*, gen. et sp. nov. ケシタマゴガヒ, 2.0×1.6mm p. 142.
 3. *Micratys ovum*, gen. et sp. nov. ナンキンタマゴガヒ, 2.0×1.6mm p. 143.
 4. *Haloa rotundata* (A. Adams) ブドウガヒ, 8.3×5.7mm. p. 149.
 5. *Nipponatys volvulinus* (A. Adams) チャボダマゴガヒ, 4.7×2.8mm p. 141.
 6. *Smaragdinella sieboldi* A. Adams タテジワミドリガヒ, 5.0×3.8mm. p. 146.
 7. *Smaragdinella calyculata* (Broderip et Sowerby) ミドリガヒ, 12.0×7.6mm p. 144.
 8. *Haloa* (*Vitreohaminoea*) *vitrea* (A. Adams) ハリブドウガヒ, 8.2×5.3mm p. 150.
 9. *Limulatys ooformis* sp. nov. ホソタマゴガヒ, 12.6×7.0mm.....p. 138.
 10. *Limulatys constricta* sp. nov. クビレタマゴガヒ, 7.0×4.5mm.....p. 140.
 11. *Diniatys monodontus* (A. Adams) イツポンバカイコガヒ, 5.3×3.0mm p. 142.
 12. *Diniatys dentifer* (A. Adams) キバカイコガヒ, 6.7×4.2mm p. 141.
 13. *Limulatys okamotoi* sp. nov. トツクリタマゴガヒ, 10.0×5.5mm.....p. 139.
 14. *Cylichnatys striatus* (Yamakawa) カミスヂカイコガヒダマシ, 4.0×1.8mm p. 142.
 15. *Lamprohaminoea cymbalum* (Quoy et Gaimard) ミガキブドウガヒ, 7.1×4.8mm..p. 151.
 16. *Haloa* (*Sericohaminoea*) *yamagutii* sp. nov. ハブタヘブドウガヒ,
 21.4×14.0mm p. 150.

Plate 20. Atyidae (1)



1870 *Linteria viridis* Sowerby, Conch. Icon., sp. 3.

1894 *Smaragdinella viridis* Pilsbry, Man. Conch., 15, p. 258, pl. 33, figs. 42, 45-53.

1931 *Smaragdinella viridis* Thiele, Handb. syst. Weicht., 1 (2), p. 387, fig. 487.

1938 *Smaragdinella calyculata* W. Adam et L. Leloup, Rés. Sci. Voy. Ind-Orient Néerland., 2 (18), p. 199.

1951 *Smaragdinella calyculata* Is. Taki, Handb. Illust. Shells, pl. 118, fig. 17.

Length 12.0mm., breadth 7.6mm. (figured specimen collected from Kashiwajima, Kochi Pref., Shikoku by Dr. T. Kuroda).

Type locality: unknown to the writer.

Distribution: Indo-Pacific region, Ryukyu and Amami groups; Shikoku and Izu Seven Islands.

Smaragdinella sieboldi A. Adams タデジワミドリガヒ

Pl. 20, fig. 6.

1864 *Smaragdinella sieboldi* A. Adams, Ann. Mag. Nat. Hist., (3) 13 (76), p. 310.

1871 *Glaucanella andersoni* Nevill, Jour. Asiatic Soc. Bengal, 11 (2), p. 2, pl. 1, fig. 13.

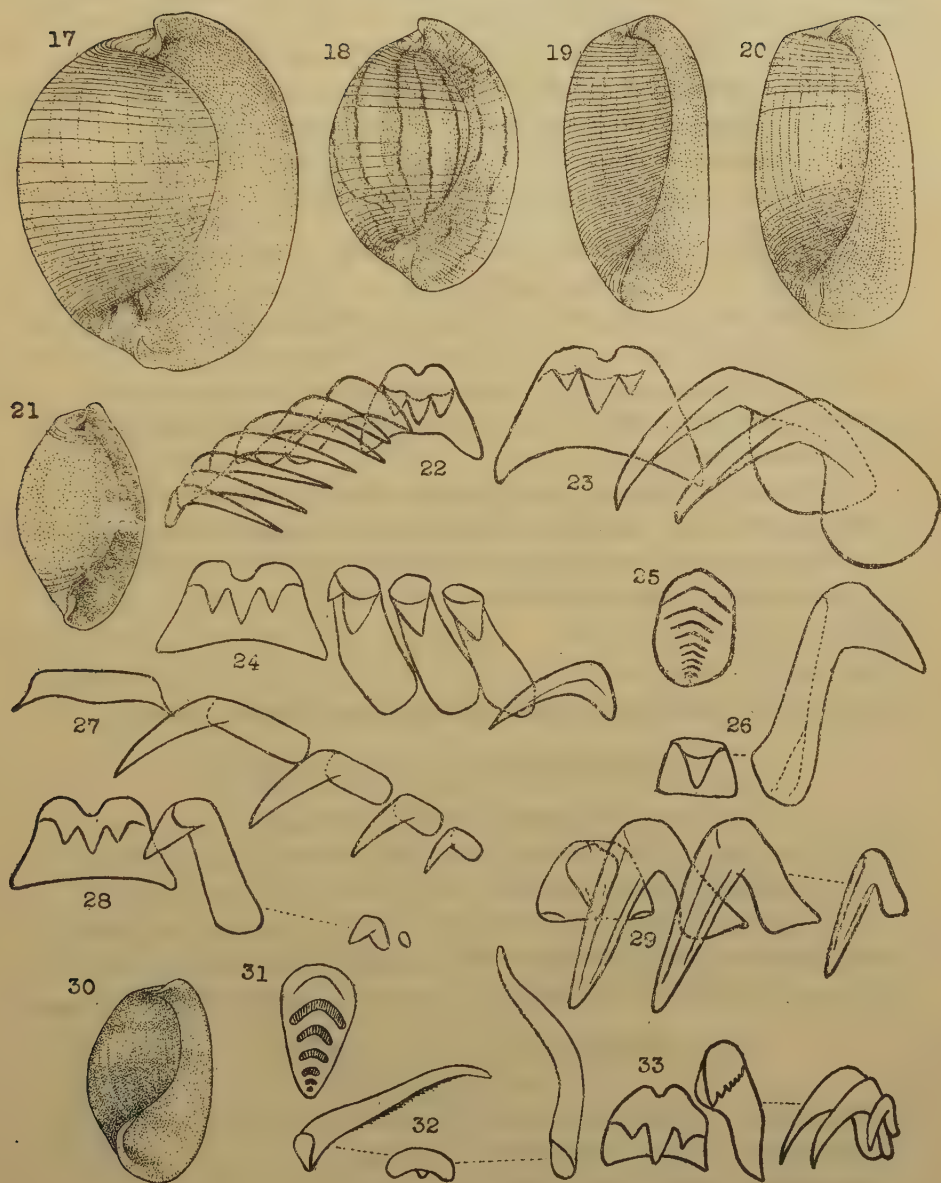
1894 *Smaragdinella andersoni* Pilsbry, Man. Conch., 15, p. 260, pl. 33, figs. 40, 41.

1894 *Smaragdinella sieboldi* Pilsbry, l. c., p. 260.

Explanation of Plate 21. 第 21 圖版説明

17. *Atys naucum* (Linné) タマゴガヒ, 50.0×40.0mm p. 137.
18. *Atys naucum* (Linné) タマゴガヒ, 24.2×16.1mm p. 137.
19. *Liloa curta* (A. Adams) トウマキカイコガヒダマシ, 17.3×8.2mm p. 151.
20. *Liloa porcellana* (Gould) カイコガヒダマシ, 18.8×8.9mm p. 151.
21. *Limulatus angustatus* (Gould) ウスミドリタマゴガヒ, 4.6×2.5mm p. 140.
22. Half transverse row of radula of *Liloa porcellana* (Gould)
カイコガヒダマシの歯舌の半横列 p. 151.
23. Rachidian and two marginal teeth of *Lamprohaminoea cymbalum* (Quoy et
Gaimard) ミガキブドウガヒの中歯と2縁歯 p. 151.
24. Rachidian and four marginal teeth of *Haloa rotundata* (A. Adams)
ブドウガヒの中歯と4縁歯 p. 149.
25. Stomachal plate of *Liloa porcellana* (Gould) カイコガヒダマシの胃板 p. 151.
26. Rachidian and one marginal tooth of *Smaragdinella calyculata* (Broderip et
Sowerby) ミドリガヒの中歯と1縁歯 p. 144.
27. Half transverse row of radula of *Nipponatys volvulinus* (A. Adams)
チャボダマガヒの歯舌の半横列 p. 141.
28. Rachidian and three marginal teeth of *Haloa (Vitreohaminoea) vitrea*
(A. Adams) ハリブドウガヒの中歯と3縁歯 p. 151.
29. Rachidian and three marginal teeth of *Lathophthalmus smaragdinus* (Rüppell et
Leuckart) テフテフミドリガヒの中歯と3縁歯 (after Baba 1936) p. 148.
30. *Haloa binotata* (Pilsbry) ニクイロブドウガヒ 19.1×12.2mm p. 148.
31. Stomachal plate of *Cylichnatys striatus* (Yamakawa)
カミスヂカイコガヒダマシの胃板 p. 142.
32. A transverse row of radula of *Cylichnatys striatus* (Yamakawa)
カミスヂカイコガヒダマシの歯舌の1横列 p. 142.
33. Radula of *Haminoea physis* (Linné) (after Bergh from Thiele 1931)

Plate 21. Atyidae (2)



Length 5.0mm., breadth 3.8mm. (figured specimen collected from Kakeromajima, Amami group by Mr. R. Kawamura).

Type locality: Takanoshima in Tateyama Bay, Chiba Pref., Honshu.

Distribution: Indo-Pacific region; Ryukyu and Amami groups; Kyushu; Shikoku and Honshu.

Genus *Lathophthalmus* Pruvot-Fol 1931 テフテフミドリガヒ属

1821 *Cryptophthalmus* Ehrenberg, Symb. Phys. Moll. sign. k, non Rafinesque 1814.

1931 *Lathophthalmus* Pruvot-Fol, Bull. Mus. Hist. Nat. Paris, **3**, p. 748.

Type species: *Cryptophthalmus olivaceus* Ehrenberg.

Lathophthalmus smaragdinus (Rüppell et Leuckart) テフテフミドリガヒ

Textfig. 3; pl. 21, fig. 29.

1828 *Bulla smaragdina* Rüppell et Leuckart, Neue Wirbellose Thiere. Rothen Meeres, p. 28, pl. 11. fig. 2.

1831 *Cryptophthalmus olivaceus* Ehrenberg, Symb. Phys., pl. 1, figs. 2, a-g.

1880 *Cryptophthalmus smaragdinus* v. Martens, Beitr. Meer. Insel Mauritius u. Seychellen, Moll., p. 129.

1895 *Cryptophthalmus smaragdinus* Pilsbry, Man. Conch., **16**, p. 37, pl. 6, figs. 29-36.

1931 *Cryptophthalmus smaragdinus* Thiele, Handb. syst. Weicht., **1** (2), p. 387, fig. 488.

1936 *Cryptophthalmus smaragdinus* Baba, Jour. Depart. Agr. Kyushu Imp. Univ., **5** (1), p. 4, pl. 3, fig. 9, textfig. 1.

Length of animal 25-40mm.

Type locality: Red Sea.

Distribution: Indo-Pacific region; Ishigaki-jima, Ryukyu group.

Subfamily Haminoeinae ブドウガヒ亜科

Genus *Haloa* Pilsbry 1921 ブドウガヒ属

1921 *Haloa* Pilsbry, Proc. Acad. Nat. Sci. Phila., **72** (1920), p. 367

1926 *Penthominea* Iredale, Austr. Zool., **5** (4), p. 351.

1952 *Parahaminoea* Kuroda et Habe, Check List Bibliogr. Rec. Mar. Moll. Japan, p. 75.

Type species: *Haminea crocata* Pease (original designation).

Remarks: The first marginal tooth of radula is provided with two cusps.

Haloa binotata (Pilsbry) ニクイロブドウガヒ

Pl. 21, fig. 30.

1895 *Haminea binotata* Pilsbry, Cat. Mar. Moll. Japan, p. 185.

1895 *Haminea binotata japonica* Pilsbry, *l. c.*, p. 185.

1896 *Haminea binotata* Pilsbry, Man. Conch., **16**, p. 231.

1896 *Haminea binotata japonica* Pilsbry, *l. c.*, p. 232.

1951 *Haminoea binotata* Is. Taki, Handb. Illust. Shells, pl. 118, fig. 19.

1952 *Parahaminoea binotata* Kurod et. Habe, Check List Bibliogr. Rec. Mar. Moll., p. 75

Length 19.1mm., breadth 12.2mm. (figured specimen collected from Kakeroma-jima, Amami group, by Mr. R. Kawamura).

Type locality: Yaeyama Islands, Ryukyu group.

Distribution: Formosa; Ryuku and Amami groups; Kyushu; Shikoku and Honshu.

Haloea rotundata (A. Adams) ブドウガヒ (ウスカハブドウガヒ)

Textfig. 4; pl. 20, fig. 4; pl. 21, fig. 24.

1850 *Bulla* (*Haminea*) *rotundata* A. Adams, Thes. Conch., 2, p. 583, pl. 124, fig. 105.

1862 *Haminea rotundata* A. Adams, Ann. Mag. Nat. Hist., (3), 9 (50), p. 155.

1868 *Haminea rotunda* Sowerby, Conch. Icon., sp. 9.

1894 *Haminea rotundata* Pilsbry, Man. Conch., 15, p. 375, pl. 41, fig. 16.

1896 *Haminea rotundata* Kobelt, Conch. Cab., 1 (9), p. 119, pl. 16, fig. 27.

1904 *Haminea rotundata* Hidalgo, Cat. Moll. Test. Filipinas, p. 279.

1939 *Haminea japonica* Nomura, Jap. Jour. Geol. Geogr., 16 (1. 2), p. 15, pl. 11, figs. 13, 14.

1945 *Haminoea cymbalum* Habe, Jap. Jour. Malac. (Venus), 14, p. 9, fig. 12.

1947 *Haminoea cymbalum* Kuroda, Illust. Encycl. Fauna Jap., p. 1086, fig. 3078.

1951 *Haminoea rotundata* Is. Taki, Handb. Illust. Shells, pl. 118, fig. 15.

Length 10.8mm., breadth 7.0mm., (examined specimen collected from Kinkai Bay, Okayama Pref., Honshu).

Type locality: Philippines?

Distribution: Philippines; Kyushu; Shikoku; Honshu and Southern Korea.

Haloea flavescens (A. Adams) アオブドウガヒ (新稱)

1850 *Bulla* (*Haminea*) *flavescens* A. Adams, Thes. Conch., 2, p. 582, pl. 124, fig. 99.

1386 *Haminea flavescens* Sowerby, Conch. Icon., sp. 31.

1894 *Haminea flavescens* Pilsbry, Man. Conch., 15, p. 374, pl. 41, fig. 15.

1896 *Haminea flavescens* Kobelt, Conch. Cab., 1 (9), p. 119, pl. 15, fig. 26.

Length 4.8mm., breadth 3.2mm. (examined specimen collected from Kakeroma-jima, Amami group by Mr. R. Kawamura).

Type locality: Unknown.

Distribution: Philippines and Amami group.

Remarks: This is a green species in general features, allied to the preceding species.

Subgenus *Vitreohaminoea* Kuroda et Habe 1952 ハリブドウガヒ 亞屬

1952 *Vitreohaminoea* Kuroda et Habe, Check List Bibliogr. Rec. Mar. Moll. Japan, p. 97.

Type species: *Bulla vitrea* A. Adams (original designation).

Remarks: The first marginal tooth of radula has only one cusp.

Haloa (*Vitreohaminoea*) *vitrea* (A. Adams) ハリブドウガヒ

Pl. 20, fig. 8; pl. 21, fig. 28.

1850 *Bulla vitrea* A. Adams, Thes. Conch., 2, p. 583, pl. 124, fig. 102.

1868 *Haminea vitrea* Sowerby, Conch. Icon., sp. 8.

1894 *Haminea vitrea* Pilsbry, Man. Conch., 15, p. 370, pl. 40, fig. 83.

Length 8.2mm., breadth 5.3mm. (figured specimen collected from Tokunoshima, Amami group)

Type locality: 'Cagayan, Island of Mindanao, Philippines.

Distribution: South-west Pacific region; Amami group and Honshu (Wakayama Pref.).

Haloa (*Sericohaminoea*) *yamagutii*, subgen. et sp. nov. ハブタヘブドウガヒ

Pl. 20, fig. 16.

1941 *Haminoea vitrea* Kuroda, Mem. Fac. Sci. Agr. Taihoku Imp. Univ., 22 (4), p. 133, pl. 3, fig. 48, non A. Adams 1850.

Shell moderate in size for the genus, thin, pale yellow, cylindrical ovate; spire involute; vertex white, with shallow concavity and slightly perforated in the centre; surface sculptured with closely set wavy, macroscopically discernible striations; aperture rather large, upper margin rising at the summit and basal margin arched; columellar margin somewhat thickened and arcuated; umbilicus not perforated. Length 21.4mm., breadth 14.0mm. (figured type specimen collected from Takao, Formosa by Mr. A. Yamaguti).

Type locality: Takao, Formosa (=Taiwan).

Distribution: Formosa and Ryukyu group.

Remarks: This new form differs from the other allied ones in having the conspicuously marked wavy striae on the surface, which are visible to the naked eyes, slightly perforated apex and the thickened columellar margin. The radular feature of this species is unknown.

Genus *Lamprohaminoea* Kuroda et Habe 1952 ミガキブドウガヒ属

1952 *Lamprohaminoea* Kuroda et Habe, Check List Bibliogr. Rec. Moll. Japan, p. 62.

Type species: *Bulla cymbalum* Quoy et Gaimard (original designation).

Remarks: The shell of this species is smooth and polished and the animal is green, dotted with many red markings. The first marginal tooth of the radula has one cusp.

Lamprohaminoea cymbalum (Quoy et Gaimard) ミガキブドウガヒ

Pl. 20, fig. 15.

1835 *Bulla cymbalum* Quoy et Gaimard, Zool. Astrolabe, 2, p. 362, pl. 26, figs. 26, 27.

1850 *Bulla* (*Haminea*) *cymbalum* A. Adams, Thes. Conch., 2, p. 580, pl. 124, fig. 90.

1868 *Haminea cymbalum* Sowerby, Conch. Icon., sp. 20.

1894 *Haminea cymbalum* Pilsbry, Man. Conch., 16, p. 367, pl. 40, figs. 6, 7.

Length 7.1mm., breadth 4.8mm. (figured specimen collected from Tokunoshima, Amami group).

Type locality: Island of Guam.

Distribution: South-west Pacific region; Ryukyu and Amami groups.

Genus *Liloea* Pilsbry 1921 カイコガヒダマン属

1921 *Liloea* Pilsbry, Proc. Acad. Nat. Sci. Phila., 72, (1920). p. 367

1951 *Haminocatys* Is. Taki, Handb. Illust. Shells, pl. 119, fig. 4.

Type species: *Haminea tomaculum* Pilsbry (original designation).

Liloea curta (A. Adams) トウマキカイコガヒダマン

Pl. 21, fig. 19.

1850 *Bulla* (*Haminea*) *curta* A. Adams, Thes. Conch., 2, p. 582, pl. 104, fig. 100.

1894 *Haminea curta* Pilsbry, Man. Conch., 15, p. 368, pl. 40, figs. 84, 85.

1921 *Haminoea* (*Liloea*) *curta* Pilsbry, Proc. Acad. Nat. Sci. Phila., 72, p. 369, fig. 8a.

Length 17.3mm., breadth 8.2mm. (figured specimen collected from Okinawa main Island, by Mr. A. Teramachi).

Type locality: Hawaii Islands?

Distribution: Middle Pacific region; Ryukyu and Amami groups.

Liloea porcellana (Gould) カイコガヒダマン

Pl. 21, figs. 20, 25.

1859 *Atys porcellana* Gould, Proc. Boston Soc. Nat. Hist., 7, p. 138.

1868 *Atys porcellana* Sowerby, Conch. Icon., sp. 30.

1882 *Cylichna semisulcata* Dunker, Index Moll. mar. Japon., p. 163, pl. 13, figs. 7-9.

1894 *Atys porcellana* Pilsbry, Man. Conch., 15, p. 268, pl. 28, fig. 23.

1894 *Cylichna semisulcata* Pilsbry, l. c., p. 303, pl. 26, figs. 78-80.

1896 *Atys porcellana* Kobelt, Conch. Cab., 1 (9), p. 26, pl. 8, fig. 11.

1928 *Cylichna incisula* Yokoyama, Imp. Geol. Surv. Japan, Rep. No. 101, p. 122, pl. 19, fig. 1.

1951 *Haminocatys semisulcata* Is. Taki, Handb. Illust. Shells, pl. 119, fig. 4.

Length 18.8mm., breadth 8.9mm. (figured specimen collected from Tanabe Bay, Wakayama Pref., Honshu).

Type locality: Kagoshima, Kyushu.

Distribution: Kyushu; Shikoku and Honshu.

Pseudococculina rosea new species (Cocculinidae)

Shell small, thin, pink in colour, patelliform, elliptical, depressed; apex placed at about two-fifths of the total length from the anterior end; anterior and posterior ends are regularly rounded; anterior slope nearly straight but the posterior slightly convex; sculpture consisting of the rather irregular concentric growth lines and very weak radial threads,

Length 5.6mm., breadth 4.8mm., height 1.4mm.

Type locality: Tosa Bay, Shikoku.

Remarks: Both of *Ps. rugosoplicata* Schepman and *Ps. granulata* Schepman are white species. Moreover the former has more elevated than this new species and the latter is differentiated from this new species by the different sculpture on its surface.

Emozamia lamellata new species (Rapidae)

Shell rather small, white, biconic in shape, distinctly angulated at the shoulder; apex acute; whorls about 6; protoconch with two smooth and polished whorls; succeeding whorls with numerous varices, eight on the body whorl, beseting the shell; they are lamellate and erect, descending obliquely from the suture passing the shoulder to the base; therefore, they are spirally converging to the apex in the apical view; the intervariceal spaces are transversely crossed by the stout spiral cords appearing about nine in number behind the aperture; aperture rather wide, narrowed below, dividing the short unclosed canal; outer margin expanded, smooth within and with concentric frills on the edge; columellar margin rather straight, but arched medially; parietal callus covered on the penultimate wall.

Height 17.7mm., breadth 13.3mm.

Type locality: Tosa Bay, Shikoku. (collected by A. Teramachi)

Remarks: *Emozamia licina* (Hedley and Petterd) is an Australian representative of this new species and is pale brown in colour with more strongly angular shoulder and less numerous spiral cords.

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Illustrated Catalogue of Japanese Shells

Edited by Dr. Tokubei Kuroda

November 30, 1952

Lyonsiidae, Poromyidae, etc.

No. 21.

日本産サザナミガヒ科, スナメガヒ科, アケビガヒ科,
マゴコロガヒ科

波部忠重

Lyonsiidae, Poromyidae, Arcticiidae, and Gaimardiidae in Japan

by

Tadashige HABE

Family Lyonsiidae サザナミガヒ科

Genus *Lyonsia* Turton 1822 サザナミガヒ屬

1822 *Lyonsia* Turton, Conch. Insularum Brit., Dithyra, p. 34.

1836 *Pandorina* Scacchi, Osserv. Zool., p. 15.

Type species: *Mya striata* Montagu (= *Mya norvegica* Gmelin) (monotypy).

Lyonsia ventricosa Gould サザナミガヒ

Pl. 22, fig. 11.

1861 *Lyonsia ventricosa* Gould, Proc. Boston Soc. Nat. Hist., 8, p. 23.

1862 *Lyonsia ventricosa* Gould, Otia Conch., p. 162.

1874 *Lyonsia rostrata* Lischke, Jap. Meer. Conchyl., 3, p. 102, pl. 9, fig. 13.

1882 *Lyonsia praetenuis* Dunker, Index Moll. Mar. Jap., p. 180, pl. 7, fig. 13.

1922 *Lyonsia praetenuis* Yokoyama, Jour. Cll. Sci. Imp. Univ. Tokyo, 44 (1), p. 169,
pl. 14, figs. 9, 10.

1951 *Lyonsia arenaria ventricosa* Is. Taki, Hirase's Handb. Illust. Shells, pl. 20, fig. 3.

1952 *Lyonsia ventricosa* Habe, Gen. Jap. Shells, 3, p. 256, fig. 693.

Length 17.0 mm., height 9.7mm., breadth 6.1 mm. (conjoined valves) (figured specimen collected from Akkeshi Bay, Hokkaido)

Type locality: Hakodate, Hokkaido.

Distribution: Kyushu; Shikoku; Honshu and Hokkaido.

Lyonsia kawamurai n. sp.

Pl. 22, fig. 1.

This new form closely resembles the preceding species in the general features, but may be easily distinguished from the latter in having the posterior margin not rostrated but broadly truncated.

Length 13.2 mm., height 10.2 mm., breadth 6.8 mm. (conjoined valves) (figured type specimen collected by Mr. R. Kawamura).

Type locality : Sagami Bay, Honshu.

Distribution : Type locality and off Noto Peninsula, Honshu.

Genus *Allogramma* Dall 1903

1903 *Allogramma* Dall, Trans. Wagner Free Inst. Sci., 3 (6), p. 1514.

Type species : *Lyonsia formosa* Jeffreys (original designation).

Subgenus *Bentholyonsia* Habe 1952 ワタゾコオビクヒガヒ 亞屬

1952 *Bentholyonsia* Habe, Gen. Jap. Shells, 3, p. 257.

Type species : *Allogramma* (*Bentholyonsia*) *teramachii* Habe (monotypy).

Allogramma (*Bentholyonsia*) *teramachii* Habe ワタゾコオビクヒガヒ

Pl. 22, figs. 12, 13; 14, 15 (showing lithodesma)

1952 *Allogramma* (*Bentholyonsia*) *teramachii* Habe, Gen. Jap. Shells, 3, p. 257, figs. 691, 692; 694, 695.

Shell white, covered with the pale yellowish periostracum, covered with radially arranged minute granules from the umbo to the ventral margin, but without any strong radial folds on the surface. The posterior extremity distinctly truncated and broadly gaped. Lithodesma large, situated behind the umbo and adhered the inner side of the dorsal margin.

Length 22.5mm., height 15.8mm., breadth 9.8mm. (conjoined valves) (figured type specimen).

Type locality : Tosa Bay, Shikoku.

Distribution : Shikoku and off Gotô Islands, Kyushu (Sôyô-maru Station No. 439, 155 m. in depth).

Genus *Entodesma* Philippi 1845 オビクヒガヒ 屬

1845 *Entodesma* Philippi, Arch. f. Naturg., 1, p. 52.

1909 *Agriodesma* Dall, Proc. U. S. Nat. Mus., 37, p. 284.

Type species : *Entodesma chilense* Philippi (monotypy).

Entodesma navicula A. Adams et Reeve オビクヒ

Pl. 22, fig. 9.

1850 *Lyonsia navicula* A. Adams et Reeve, Zool. Voy. Samarang, Moll., p. 83, pl. 23, fig. 11.

1875 *Mytilimeria navicula* Sowerby, Conch. Icon., sp. 5.

1895 *Entodesma truncatissima* Pilsbry, Cat. Mar. Moll. Japan, p. 137, pl. 3, figs. 11, 12.

Length 20.4 mm., height 12.8 mm., breadth 9.6 mm. (conjoined valves) (figured specimen collected from Sagami Bay by Mr. R. Kawamura).

Type locality: Borneo.

Distribution: Borneo; Kyushu; Shikoku; Honshu and Hokkaido.

Entodesma naviculoides Yokoyama フトオビクヒガヒ

Pl. 22, figs. 5, 6.

1922 *Entodesma naviculoides* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 44 (1), p. 170, pl. 6, fig. 11.

1937 *Entodesma truncatissima* Kinoshita, Suisan Chosa Hokoku (Hokkaido Fisheries Experimental Station). no. 41, p. 31, pl. 9, fig. 54.

1952 *Entodesma naviculoides* Habe, Gen. Jap. Shells, 3, p. 257, figs. 684, 685.

Length 68.0 mm., height 40.6 mm., breadth 34.9 mm. (conjoined valves) (figured specimen collected from Akkeshi Bay, Hokkaido)

Type locality: Shito, Ichihara Gun, Chiba Pref., Honshu (fossil).

Distribution: Northern Honshu and Hokkaido.

Family Poromyidae スナメガヒ科

Genus *Poromya* Forbes 1844 スナメガヒ屬

1844 *Poromya* Forbes, Rep. Brit. Assoc. Adv. Sci (1843), p. 191.

1846 *Embla* Lovén, Ind. Moll. Scand., p. 46.

1856 *Thetis* H. et A. Adams, Gen. Rec. Moll., 2, p. 367.

Type species: *Poromya anatinoides* Forbes (= ? *Corbula granulata* Nyst et West) (monotypy).

Poromya flexuosa Yokoyama スナメガヒ

Pl. 22, figs. 16, 17.

1922 *Poromya flexuosa* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 44 (1), p. 173, pl. 14, figs. 15, 16.

1952 *Poromya flexuosa* Habe, Gen. Jap. Shells, 3, p. 273, figs. 729, 730.

Length 15.6 mm., height 13.7 mm., breadth 5.2 mm. (left valve) (figured specimen collected from off Tsushima between Kyushu and Korea).

Type locality: Shito, Ichihara Gun, Chiba Pref., Honshu. (fossil)

Distribution: Honshu (off Inubo-Zaki, Chiba Pref., Sôyô-maru Station No. 12, 325 m. in depth; off Katsuura, Chiba Pref., St. 4, 287 m.; Sagami Bay; off Shimoda, Izu Peninsula, St. 259, 188 m.; off Atsumi Peninsula, Aichi Pref., St. 371, 84m.; entrance of Ise Bay, St. 384, 21-38m.; off Tanabe, Wakayama Pref., St. 352, 154m.; off Tsugaru Peninsula, Aomori Pref., St. 646, 123 m.; Wakasa Bay; off Fukui Pref., St. 546, 101 m.; St. 549, 115 m.; off Tottori Pref., St. 523, 181m.; off Izumo Peninsula, Shimane Pref., St. 520, 75m. off Oki Islands, St. 503, 146m.; St. 504, 106m.; off Hamada, Shimane Pref., St. 493, 124m.; St. 494, 110m.; off Mishima, Yamaguchi Pref., St. 486, 139m.; off Hagi, Yamaguchi Pref., St. 471, 90 m.); Shikoku (off Aki-cho, Kochi Pref., St. 221, 209 m.); Kyushu (off Goto Islands, St. 432, 148 m.; St. 439, 155m.; St. 440, 152 m.; St. 444, 194 m.; St. 451, 187 m.; St. 452, 154m.; off Fukuoka, St. 470, 73 m.; off Tsushima, St. 475, 192 m.).

Poromya castanea new species クリイロスナメガヒ

Pl. 22, fig. 10.

Shell triangularly ovate, rounded anteriorly, narrowed posteriorly, covered with thickish brown periostracum all over the surface; umbo prominent and prosogyrate; surface covered with numerous minute granules which are regularly and radially arranged; an obtuse flexure runs from the umbo to the postero-dorsal corner; interior pearly and polished; ventral margin of shell simple and entire.

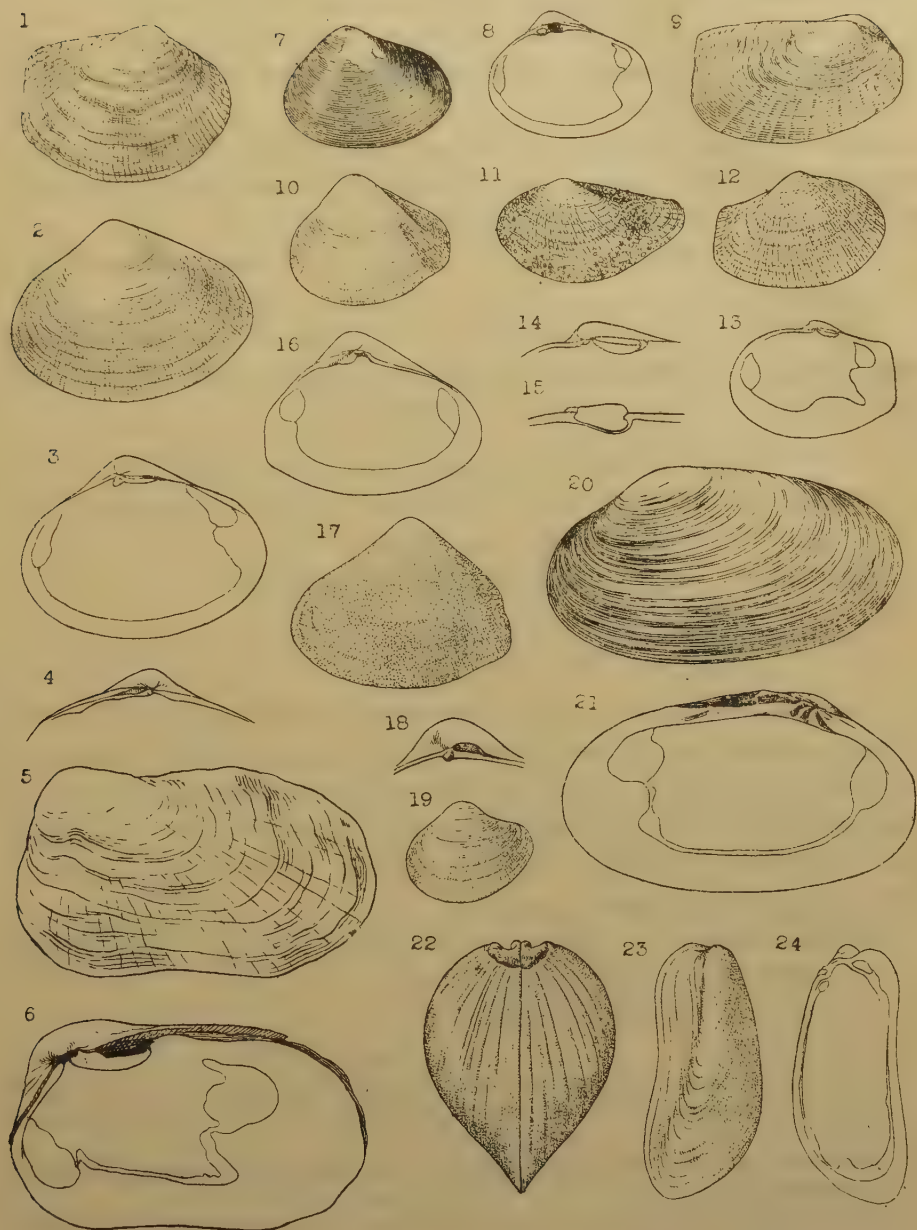
Length 15.0mm., height 12.7mm., breadth 5.0mm. (left valve) (figured type specimen).

Type locality; Off Oki Islands in the Japan Sea (Soyo-maru St. No. 499, 307m in depth)

Explanation of Plate 22 第 22 図版説明

- Fig. 1. *Lyonsia kawamurai* n. sp. 13.2×10.2mm. p. 154.
 2, 3, 4. *Cetoconcha japonica* n. sp. 16.2×13.0mm. p. 158.
 5, 6. *Entodesma naviculoides* Yokoyama フトオビクヒ 68.0×40.6mm. p. 155.
 7, 8. *Dermatomya tenuiconcha soyoae* n. var. ビワノタネ 16.1×12.8mm. p. 157.
 9. *Entodesma navicula* (A. Adams et Reeve) オビクヒ 20.4×12.8mm. p. 155.
 10. *Poromya castanea* n. sp. クリイロスナメガヒ 15.0×12.7mm. p. 156.
 11. *Lyonsia ventricosa* Gould サザナミガヒ 17.0×9.7mm. p. 153.
 12, 13, 14, 15. *Allogramma* (*Bentholysia*) *teramachii* Habe ワタゾコオビクヒ 22.5×15.8mm. p. 154.
 16, 17. *Poromya flexuosa* Yokoyama スナメガヒ 15.6×13.7mm. p. 155.
 18, 19. *Cetoconcha* (*eximia* var. ?) *intermedia* n. sp. ビイドロスナメガヒ 12.0×9.9mm. p. 159.
 20, 21. *Akebiconcha kawamurai* Kuroda アケビガヒ 76.4×43.4mm. p. 159.
 22, 23, 24. *Peregrinamor ohshimai* Shoji マゴコロガヒ 5.5×13.2mm. p. 159.

Plate 22. Lyonsiidae, Poromyidae,
Arcticidae, Gaimardiidae.



Genus *Dermatomya* Dall 1889 ビワノタネガヒ屬

1889 *Dermatomya* Dall, Proc. U. S. Nat. Mus., **12**, p. 289.

Type species: *Poromya mactroides* Dall (original designation.)

Dermatomya tenuiconcha soyoae new var. ビワノタネガヒ

Pl. 22, figs. 7, 8.

1952 *Poromya* (*Dermatomya*) *soyoae* Habe, Gen. Jap. Shells, **3**, p. 274, figs. 724, 728 (name and figures only).

Shell nearly identical with *Dermatomya tenuiconcha* Dall 1913¹⁾ from off Monterey Bay, California, but more produced posteriorly. It may be differentiate under the name, *soyoae* as its variety.

Length 16.1mm., height 12.8mm., breadth 10.4mm. (conjoined valves) (figured type specimen).

Type locality: Off Hachinohe City, Aomori Pref., (Sōyō-maru St. No. 71, 444m. in depth); off Kuji, Iwate Pref. (St. 62, 631 m. in depth); off Kinkazan, Miyagi Pref. (St. 33, 331 m. in depth), Honshu.

Genus *Cetoconcha* Dall 1886 ビイドロスナメガヒ屬

1885 *Silenia* Smith, Rep. Sci. Res. Challenger, Zool., **13**, p. 75, non Mulsant 1873.

1886 *Cetoconcha* Dall, Bull. Mus. Comp. Zool., **12**, p. 280.

Type species: *Lyonsia bulla* Dall (original designation).

Cetoconcha (eximia var ?) intermedia new species ビイドロスナメガヒ

Pl. 22, figs. 18, 19.

This form resembles *C. eximia* Prashad²⁾ in general features, but is more strongly rostrated upwardly and gaped behind and more broadly truncated at the posterior extremity. *C. gloriosa* Prashad³⁾ also allied to this new form, yet the former is less flattened, with longer and much attenuated rostration. *C. transversa* (Dall, Bartsch et Rehder)⁴⁾ from the Hawaiian Islands is more rounded in which is only weakly rostrated behind.

Length 12.0mm., height 9.9mm., breadth 8.7mm. (conjoined valves) (figured type specimen collected by Mr. A. Teramachi).

Type locality: Tosa Bay, Shikoku.

- 1) *Poromya* (*Dermatomya*) *tenuiconcha* Dall, Proc. U. S. Nat. Mus., **45**, p. 596 (1913); *Poromya tenuiconcha* Oldroyd, Mar. Shells W. Coast America, **1**, p. 95, pl. 54, figs. 24-26 (1924).
- 2) *Cetoconcha eximia* Prashad, Siboga Exped., monogr. **53c**, p. 327, pl. 7, figs. 31, 32 (1924).
- 3) *Cetoconcha gloriosa* Prashad, *l. c.*, p. 326, pl. 7, figs. 29, 30 (1924).
- 4) *Poromya transversa* Dall, Bartsch et Rehder, Bernice P. Bishop Mus., Bull. **153**, p. 224, pl. 57, figs. 5, 6. (1938).

Cetoconcha japonica new species.

Pl. 22, figs. 2, 3, 4.

Shell medium in size, thin, semipellucid, slightly pearly, partly covered with a thin, pale yellowish periostracum, ovate in shape, rounded in front, weakly rostrated behind, truncated and gaped at the extremity; umbo rather prominent, anterior dorsal margin slightly shorter than the posterior; surface sculptured with minute and elevated granules, which are regularly arranged all over, except the umbonal area.

Length 16.2 mm., height 13.0 mm., breadth 8.9 mm. (conjoined valves) (figured type specimen deposited in the Saito Hoon Kai Museum: Reg. No. 15968).

Type locality: Off Kinkazan, Miyagi Pref., Honshu (Soyo-maru, St. No. 32, depth 611 m. in depth).

Distribution: Besides the type locality, Tosa Bay, Shikoku (collected by Mr. A. Teramachi).

Remarks: The specimen from Tosa Bay is somewhat elongate in form, measuring 14.5 mm. in length and 10.7 mm. in height, which could not find any specific distinction from the type specimen. *C. butoni* Prashad⁵⁾ from the Buton Strait is another allied species, but is a smaller rounded species.

Family Arctiidae

Genus *Akebiconcha* Kuroda 1943 アケビガヒ属

1943 *Akebiconcha* Kuroda, Jap. Jour. Malac. (Venus), 13, p. 17.

Type species: *Akebiconcha kawamurai* Kuroda (monotypy).

Akebiconcha kawamurai Kuroda アケビガヒ

Pl. 22, figs. 20, 21.

1943 *Akebiconcha kawamurai* Kuroda, Jap. Jour. Malac. (Venus), 13, p. 17, textfigs. 1-3.

1951 *Akebiconcha kawamurai* Habe Gen. Jap. Shells, 2, p. 117, figs. 246, 249.

1951 *Akebiconcha kawamurai* Minato et Uozumi, Sinneidai no Kenkyu, 9, p. 22, fig. 110.

Length 76.4 mm., height 43.4 mm., breadth 28.3 mm. (conjoined valves) (figured type specimen).

Type locality: Off Odawara in Sagami Bay, Honshu.

Family Gaimardiidae

Genus *Peregrinamor* Shoji 1938 マゴコロガヒ属

1938 *Peregrinamor* Shoji, Venus, 8, p. 124.

Type species: *Peregrinamor ohshimai* Shoji (monotypy).

5) *Cetoconcha butoni* Prashad, Siboga Exped., monogr. 53c, p. 327, pl. 7, figs. 33, 34 (1932).

Peregrinamor ohshimai Shoji マゴコロガヒ

Pl. 22, figs. 22, 23, 24.

1936 *Erycina* sp. Miyazaki, Jour. Imp. Fisher. Inst., 31 (2), p. 38, pl. 12 and textfig. 1.

1938 *Peregrinamor ohshimai* Shoji, Venus, 8, p. 124, pls. 3, 4.

Length 5.5 mm. height 13.2 mm., breadth 10.0 mm. (conjoined valves)
(figured paratype specimen)

Type locality: Fukuoka Bay, Kyushu.

Distribution: Kyushu (Fukuoka Bay and Ariake Bay) and Honshu (Kojima Bay, Osaka Bay, Tokyo Bay).

Remarks: This species was known as commensal animal on the ventral surface of the cephalothrax of a decapod crustacean, *Gebia major* de Haan.

Divalucina soyoae (Habe MS.) n. sp. セワケツキガヒ

1952 *Divalucina soyoae* Habe, Genera Jap. Shells, 2, p. 133, fig. 292 (name and figure only)

Shell medium in size, orbicular, almost equilateral, rather thin, white to light pink in colour, with divaricate sculpture, forming an angle on a line from the umbo to the antero-ventral corner and numbering about fifty ridges in the type specimen; postero-dorsal edge straight; antero-dorsal margin a little alate, and the posterior end slightly truncate; ventral margin round; unbo placed about in the centre of the dorsal margin and directed forwardly; lunule long and narrow, tapering anteriorly; a pseudolunule (an area without divaricating sculpture) is formed below the lunule, which is very narrow; besides the divaricating sculpture, the surface with the fine growth lines which are sometimes marking several distinct resting undulations; the right valve with a strong cardinal tooth in the centre of the hinge line and an anterior cardinal in front, the latter is smaller than the former and obliquely, directed, the anterior lateral tooth far apart from the cardinals and the posterior lateral is only inconspicuously marked; anterior scar is large and elongate and the posterior ovate in shape; pallial line simple; ventral margin smooth.

Length 28.5mm., height 27.0mm., breadth 6.8mm (right valve) type specimen deposited in the Saito Ho-on Kai Museum: Reg. No. 15396)

Type locality: Off Gotô Islands, Kyushu (Sôyô-maru Station No. 444, 194m. in depth)

Distribution: Besides the type locality and also from Tosa Bay, Shikoku (collected by A. Teramachi).

Remarks: *Divalucina cumingii* A. Adams et Angas from East Australia is the type species of this genus, which is decidedly globose with a flexure beneath the lunule. *Divaricella irpea* Smith from North Australia belongs to the genus *Divaricella*, which is defined in lacking the anterior lateral with two small not bifid cardinals.

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On a New Deep-sea Alcyonarian from Sagami Bay,
Carotalcyon sagamianum n. gen. et n. sp.

With 1 Text-figure

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(Communicated by T. KOMAI)

Last year, while examining the vast collections of marine animals preserved in the museum of the Zoological Institute of Tokyo University by permission of Prof. K. Takewaki, I happened to find a remarkable alcyonarian, appearing aberrant both in shape and in color. This interesting specimen was obtained by Kumakichi Aoki with a long line at a depth of 170 "hiro" (=280 meters) in Sagami Bay during the late Prof. Ijima's collecting survey for Hexactinellid sponges in 1895, and since has been preserved in that museum. It is certainly surprising that such a remarkable animal has remained unnoticed for so many years.

On examination I confirmed that it represented a new and very remarkable Alcyoniid type, showing an affinity with the deep-sea dimorphic alcyonarians, *Anthomastus* and *Bathyalcyon*, both of which have been found in the same bay (Kükenthal 1910; Kinoshita 1911). As the animal resembles a carrot in its external appearance and coloration, I wish to call it *Carotalcyon sagamianum*, n. gen. et n. sp.

Carotalcyon sagamianum, n. gen. et n. sp.*Locality.* Sagami Bay, 170 "hiro" (=280 m) in depth. April 2, 1895.

External appearance. The single well-preserved colony is coral-red or carrot-like in color, and measures about 7 cm in length, from the outer border of the basal disc to the top of the polyparium. It consists of a somewhat contracted capitulum bearing some robust finger-like processes and a rigid columnar sterile stalk. Thus it resembles the forms of Fasciculariidae (e. g. *Paralcyonium*, *Studeriotis* and *Fascicularia*) more than those of Alcyoniidae (e.g. *Anthomastus*, *Bathyalcyon*,

Sarcophyton, *Acrophytum*, *Metalcyonium*, etc.).

The stalk is tough in texture and has a height of 45 mm (about 35 mm along the central axis). It bears an expanded marginal ridge at the top and is somewhat depressed at its center to form the capitular disc. The base is hollowed out to give attachment to the substratum; it measures about 27 mm in the maximum diameter. The outer surface of the stalk is much wrinkled, as the result of strong contraction. No ornamentation of particular spicules, as is seen in the family Fasciculariidae, is found.

The capitular disc measures about 22×25 mm and is somewhat depressed. It carries more than a dozen finger-like processes, completely covered by polyps. The basal part of the polyparium does not protrude beyond the marginal border of the capitulum, so that the precise mode of branching can hardly be detected. The finger-like processes, when protruded, measure in length from 9 mm to 25 mm and have an average diameter of 4-7 mm at the base. Most of them are stocky, slightly branched distally, and roundly ended; also some unbranched processes may be found.

The polyps are dimorphic, as in most of the genera of Alcyoniidae, and have both kinds of zooids only on the finger-like processes and the capitular disc. The surface covered by these polyps looks very uneven and tuberoso. The autozooids are completely retractile, comparatively few in number, and about 1-2 mm apart. Between these zooids there are distinct siphonozooids, arranged at intervals of about 0.3-0.6 mm. The autozooids, when completely retracted, form very prominent papillae, 8-lobed and with a central pit. The siphonozooids appear to the naked eye as faintly colored and slightly elevated tiny spots, due to the lack of colored spicules.

When fully expanded, the autozoid is flexible and wholly white, but not transparent, so that the stomodaeum and mesenteries are not visible from outside. It measures about 1.2 mm in length, excluding the tentacles and about 0.8-0.9 mm in diameter. The very characteristic feature of the autozoid is the lack of spiculation of the polyp body and the 2-rowed pinnules in the tentacles. The tentacles are about 1 mm long and 0.3 mm wide at the base. The aboral side of the rachis is strongly convex in cross section, while the oral side is flattened and provided with 2 rows of low conical pinnules on either side of the broad median streak, as found in the Xeniids. The pinnules number about 10 in the inner row and 12-16 in the outer row. The longest pinnule is 0.18 mm long and 0.07 mm wide in the middle. The mouth is as large as 0.5 mm, and its margin is prominently elevated above the oral disc.

Dissection shows the internal structure of zooids to a certain extent. When the polyp body is removed, the autozooid shows a spacious lumen of the stomodaeum and coelenteron. The opening is provided with 8 conical lobes covered densely with colored spicules, which are the pseudo-oral extension of the coenenchymal epithelium. The stomodaeum lying below is a relatively short tube, about 0.3 mm in length and 0.8 mm in diameter, and surrounded by a thick wall, which is considerably striated transversely by the development of musculature. Eight strong mesenteries extend downwards from the edge of the stomodaeum into the coelenteron.

The siphonozooids are uniformly distributed over the surface of the polyparium and capitular disc. No trace of tentacles or lobes is found around the mouth. The siphonozooids are connected with one another by means of a canal system, the solenia, and also with the coelenteron of the autozooids by short and wide canals. The stomodaeum is very short, measuring about 0.18 mm in diameter, and leads into the larger coelenteron, which is subdivided by the eight mesenteries as usual. Of the mesenteries only the two dorsal ones possess thickened edges or mesenterial filaments. The remaining six mesenteries are very feeble, and only one or two of them carry a single gonad in the deeper part. When ripe the gonad forms a spherical body, measuring about 0.2 mm in diameter. In this respect this alcyonarian shows a closer resemblance to *Bathyalcyon* than to any other form. But the number of mesenteries in the siphonozooids is always eight as in *Anthomastus* and other dimorphic alcyonarians, instead of being only six as in *Bathyalcyon* (cf. Kükenthal 1906, Cylkowski 1911, Molander 1915 and Bock 1938).

Spiculation. As mentioned above, the extensible autozooids are entirely devoid of spicules. Characteristic spicules occur only in the coenenchyme, and are far more numerous in the periphery, where they are densely crowded, than in the deeper parts of the stalk. All the spicules are very minute, as compared with those in other ordinary Alcyoniids, and caroty or coral-red in color. The characteristic color of the colony is solely due to the spicules. The spicules may be classified into the following three types according to their shape and location.

In the canal-walls of the polyp-bearing processes, only thorny rods (Fig. 1, *k*) occur sparsely; they measure: 0.046×0.012 mm, 0.056×0.018 mm, 0.06×0.018 mm. In the cortex of these processes, dump-bell spicules of the double-stars type (Fig. 1, *h-j*) are densely distributed; they measure: 0.05×0.028 mm, 0.06×0.036 mm. In the barren stalk, the periphery is very thick, reaching up to about 3 mm in thickness,

compact in texture and densely filled with spicules of the double-crosses type (Fig. 1, *f-g*), of which the regularly shooting prominences, typically 8 in number, are always headed like a rivet with 6-8 pointed



Fig. 1. *Carotalcyon sagamianum*, n. gen. et n. sp.

a, holotype, slightly reduced; *b*, a polyp-bearing finger-like process $\times 3$; *c*, fully expanded autozooid, two tentacles in front being omitted $\times 27$; *d*, tentacle of autozooid with 2 rows of pinnules, viewed from oral side $\times 50$; *e*, inner view of the arrangement of two zooids, slightly schematized after a camera drawing $\times 20$; *f*, dumb-bell spicule from sterile stalk, viewed from side $\times 330$; *g*, the same, viewed from above $\times 330$; *h*, *i*, dumb-bell spicule from periphery of polyparium, viewed from side $\times 330$; *j*, the same, viewed from above $\times 330$; *k*, rod-like spicule from canal-walls of polyparium, viewed from side $\times 330$.

[*a* autozooid, *dm* dorsal mesentery of siphonozooid, *e* ova, *s* siphonozooid, *st* stomodaeum of autozooid.]

warts around the edge. They are a little larger than the above double-stars, being usually about 0.07×0.06 mm, 0.09×0.06 mm. They occur also in the deeper parts of the stalk, though not so densely as in the periphery.

SYSTEMATIC POSITION

Alcyoniidae include some aberrant forms recorded from various localities, such as *Anthomastus*, *Bathyalcyon*, *Acrophytum*, *Malacacanthus*, *Daniela* and *Cereopsis*. These genera are all monotypic, with the exceptions of *Anthomastus* and *Cereopsis*. The first three genera have dimorphic polyps, while the remaining three have monomorphic polyps.

The present alcyonarian seems to be most closely related to *Anthomastus* on account of the polyp dimorphism and spiculation. On the other hand, this somewhat resembles the genera of Fasciculariidae, especially *Paralcyonium elegans* M.-Edw., which family is characterized by the whole polyparium being withdrawn into the sterile stalk. In the present form, however, the polyparium is partially retracted within the sterile stalk, and the exact mode of branching is difficult to examine. Judging from the rigidity and compactness of the stalk, it seems very doubtful whether the polyparium can be wholly withdrawn as in all the forms of Fasciculariidae (cf. Motz-Kossowska & Fage 1907, Kükenthal 1924, Thomson 1929, Hickson 1930, Thomson & Dean 1931 and Stiasny 1941).

For the same reason it seems unlikely that the coelenteron of the autozooids extends even to the base of the colony. I did not dare to dissect the stalk to ascertain the state of coelenteron as the specimen is unique and too valuable. In any case, the closest relationship of the present alcyonarian to the genera *Anthomastus* and *Bathyalcyon* can hardly be denied. At the same time the present alcyonarian has some characteristics which are generically distinct from both the allied genera. These three genera may be included together in a specialized group amongst the family Alcyoniidae (corresponding to Anthomastinae of Bock). The diagnosis of the new genus *Carotalcyon* may be given as follows:

Carotalcyon, n. gen.

Columnar Alcyoniid colonies consisting of a capitular disc bearing finger-like processes provided with polyps, and a sterile stalk. Polyp dimorphism exists. Autozooids rather few, large, and retractile. Siphonozooids numerous, and with gonads. Spicules confined to coenenchyma and not found in polyps. Spicules of polyparium are double-stars in cortex and thorny rods in canal-walls. All stalk spicules are double-crosses.

ACKNOWLEDGEMENTS: Sincere thanks are due to Prof. K. Takewaki for placing this precious material at my disposal and also to Dr. T. Komai for constant encouragement and helpful suggestions.

LITERATURE CITED

- Bock, S. 1938. Kungl. Sv. Vet. Akad. Handl., Ser 3, 16 (5): 1-54, pls. 1, 2.
 Cylkowski, B. 1911. Untersuchungen über den Dimorphismus bei den Alcyonarien. Inaug.-Diss., Breslau.
 Hickson, S. J. 1930. Proc. Zool. Soc. London, 1930: 229-252.
 Kinoshita, K. 1911. Zool. Mag. (Tokyo), 23: 121-124, pl. 3.
 Kükenthal, W. 1906. Wiss. Ergebn. Deut. Tiefsee-Exped. "Valdivia", 13 (1): 1-111, pls. 1-12.
 ——— 1910. Abh. math.-phys. Kl. K. Bayer. Akad. Wiss., I, Suppl.-Bd. 9 Abh.: 1-16, pl. 1.
 ——— 1924. Kükenthal & Krumbach's Handbuch der Zoologie, 1: 690-769.
 Molander, A. R. 1915. Kungl. Sv. Vet. Akad. Handl., 51 (11): 1-94, pls. 1-3.
 Motz-Kossowska, S. & Fage, L. 1907. Arch. Zool. Exp. et Gén., 7: 423-443.
 Stiasny, G. 1941. Pubbl. Staz. Napoli, 19: 1-47.
 Thomson, J. A. 1929. Bull. Inst. Océanogr. Monaco, 534: 1-10.
 Thomson, J. A. & Dean, L. M. I. 1931. Siboga-Expeditie, 13d: 1-227, pls. 1-28.

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Illustrated Catalogue of Japanese Shells

Edited by Dr. Tokubei Kuroda

December 20, 1952 Astartidae, Crassatellitidae, etc.

No. 22.

日本産エゾシラヲガヒ科・モシホガヒ科・チドリマスホガヒ科・
ソトホリガヒ科

波 部 忠 重

Astartidae, Crassatellitidae, Mesodesmatidae and Laternulidae

by

Tadashige HABE

Family Astartidae エゾシラヲガヒ科

Genus *Astarte* Sowerby 1816 ハコダテシラヲガヒ屬1816 *Astarte* Sowerby, Min. Conch. Great Britain, 2, p. 85.Type species: *Astarte lurida* Sowerby (designated by Stoliczka 1871)Subgenus *Astarte* s. s. ハコダテシラヲガヒ亞屬*Astarte hakodatensis* Yokoyama ハコダテシラヲガヒ

Pl. 23, figs. 2, 3.

1920 *Astarte hakodatensis* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 39 (6), p. 140, pl. 11, figs. 5, 6.1935 *Astarte hakodatensis* Otuka, Bull. Earthq. Res. Inst., 13 (4), p. 889, pl. 56, figs. 148, 149, 150.

Length 9.7 mm., height 9.3 mm., breadth 2.7 mm. (right valve) (figured specimen collected from off Tsushima: Soyo-maru St. No. 475, 192 m. in depth).

Type locality: Koshiba, Kanagawa Pref., Honshu (Pleistocene).

Distribution: Off Goto Islands, Kyushu (Soyo-maru St. No. 452, 154 m. in depth).

Subgenus *Tridonta* Schumacher 1817 エゾシラヲガヒ亞屬1817 *Tridonta* Schumacher, Essai Nouv. Syst. Vers. Test., p. 146.

Type species: *Tridonta borealis* Schumacher (monotypy).

Astarte (Tridonta) borealis (Schumacher) エゾシラヲガヒ

Pl. 23, figs. 19, 20.

- 1817 *Tridonta borealis* Schumacher, Essai Nouv. Syst. Vers. Test., p. 146, pl. 17, fig. 1.
1824 *Astarte arctica* Gray, Parry's Voy., p. 243.
1847 *Astarte borealis* Philippi, Abbild. Beschr. Conch., 2, p. 58, pl. 1, fig. 11.
1849 *Astarte corrugata* Middendorff, Mém. Acad. Imp. Sc. St. Pétersbourg, (6) 6, p. 562, pl. 17, figs. 4—10, non Brown 1827 (*Crassina*)
1854 *Astarte arctica* Sowerby, Thes. Conch., 2, p. 780, pl. 167, figs. 17, 18, 20.
1858 *Astarte rollandi* Bernardi, Jour. de Conchyl., 7, p. 386, pl. 13, fig. 4.
1874 *Astarte arctica* Sowerby, Conch. Icon., sp. 21.
1874 *Tridonta borealis* G. O. Sars, Moll. Reg. Arct. Norvegiae, p. 50, pl. 5, fig. 8.
1903 *Astarte borealis* Dall, Proc. U. S. Nat. Mus., 26, pp. 941, 944.
1912 *Astarte borealis* Jensen, Danish Ingolf Exped., 2 (5), p. 92, pl. 4, figs. 1a—f.
1919 *Astarte borealis* Lamy, Jour. de Conchyl., 64, p. 93.
1922 *Astarte borealis* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 44, (1), p. 163, pl. 10, fig. 11.
1926 *Astarte borealis* Yokoyama, Jour. Fac. Sci. Imp. Univ. Tokyo, (2) 1 (8), p. 298, pl. 37, figs. 2, 3.
1934 *Astarte borealis* Kinoshita et Isahaya, Rep. Fish. Exper. Stat. Hokkaido, 33 (1), p. 15, pl. 11, fig. 79.
1947 *Astarte (Tridonta) borealis* Hirase et Kuroda, Illustr. Encycl. Fauna Japan, p. 1237, fig. 3518.
1951 *Astarte borealis* Is. Taki, Hirase's Handb. Illust. Shells, pl. 21, fig. 3.
1951 *Astarte borealis* Habe, Genera Jap. Shells, 2, p. 104, figs. 204, 205.

Length 35.2 mm., height 29.0 mm., breadth 12.7 mm. (conjoined valves)
(figured specimen collected from off Kamaishi, Iwate Pref., Honshu; Soyo-maru St. No. 152, 377 m. in depth)

Type locality: unknown to the writer.

Distribution: North Atlantic region; Arctic and Bering seas: Kurile Islands; Hokkaido; off Yosa Peninsula, Kyoto Pref. (Soyo-maru St. No. 541, 150 m. in depth), and off Shimane Pref. (Soyo-maru St. No. 498, 139 m. in depth), Honshu; off Tsushima, Kyushu (Soyo-maru St. No. 481, 143 m. in depth).

Astarte (Tridonta) alaskensis Dall アラスカシラヲガヒ

Pl. 23, fig. 8.

- 1849 *Astarte scotica* Middendorff, Mém. Acad. Imp. Sci. St. Petersburg, (6) 6, p. 560, pl. 16, figs. 10—12, non Maton et Rackett 1808 (*Venus*).

- 1883 *Astarte semisulcata placenta* Leche, Vega Exped., **3**, p. 441, pl. 34, figs. 35, 36, non Mörch 1857.
- 1903 *Astarte alaskensis* Dall, Proc. U. S. Nat. Mus., **26**, p. 944, pl. 63, fig. 2.
- 1924 *Astarte alaskensis* Oldroyd, Mar. Shells West Coast N. America, **1**, p. 106, pl. 13, fig. 20.
- 1926 *Astarte sulcata* Yokoyama, Jour. Fac. Sci. Imp. Univ. Tokyo, (2) **1** (8), p. 298, pl. 37, figs. 9, 10, non Da Costa 1778.
- 1933 *Astarte undata* Sasaki, Suisan-kenkyusi, **3**, p. 16, pl. 2, fig. 14, non Gould 1841.
- 1935 *Astarte alaskensis* Otuka, Bull. Earthq. Res. Inst. **13** (4), p. 890, pl. 57, fig. 195.
- 1935 *Astarte alaskensis* Nomura et Hatai, Saito Ho-on Kai Mus., Res. Bull. **6**, p. 113, pl. 12, figs. 6, 7.

Length 31.5 mm., height 26.0 mm., breadth 14.0 mm. (after Dall 1903).

Type locality: Northwest of Unimak Island, in the southern part of Bering Sea).

Distribution: Bering Sea; Hokkaido; off Oki Islands in the Japan Sea (Soyo-maru St. No. 511, 267 m. in depth).

Astarte (Tridonta) vernicosa Dall スダレシラヲガヒ

Pl. 23, fig. 22.

- 1883 *Astarte warhami* Leche, Vega Exped., **3**, pl. 32, figs. 7, 8, non Hancock 1846.
- 1903 *Astarte vernicosa* Dall, Proc. U. S. Nat. Mus., **26**, p. 948, pl. 63, fig. 1.

Length 25.1 mm., height 20.3 mm., breadth 12.7 mm. (conjoined valves) (figured specimen collected from the Volcanic Bay (Funkawan), Hokkaido).

Type locality: Off Icy Cape, Arctic Sea.

Distribution: Arctic and Bering Seas; Hokkaido; off Yosa Peninsula, Kyoto Pref., Honshu (Soyo-maru St. No. 541, 150 m. in depth).

Astarte (Tridonta) bennettii Dall コエゾシラヲガヒ

Pl. 23, fig. 1.

- 1903 *Astarte bennettii* Dall, Proc. U. S. Nat. Mus., **26**, p. 946, pl. 63, fig. 6.
- 1935 *Astarte aomoriensis* Nomura et Hatai, Saito Ho-on Kai Mus., Res. Bull. **6**, p. 115, pl. 9, fig. 5.

Length 15.5 mm., height 13.8 mm., breadth 7.7 mm. (conjoined valves) (figured specimen collected from off Kuji, Iwate Pref., Honshu: Soyo-maru St. No. 65, 215 m. in depth).

Type locality: North part of Bering Sea.

Distribution: Arctic and Bering Seas; Hokkaido; off Shimane Pref., Honshu (Soyo-maru St. No. 495, 146 m. in depth; No. 491, 112 m. in depth); off

Tsushima (Soyo-maru St. No. 475, 192 m. in depth) ; off Goto Islands, Kyushu (Soyo-maru St. No. 439, 155 m. in depth).

Family Crassatellitidae モシホガヒ科

Genus *Crassatellites* Krüger 1823 モシホガヒ屬

1823 *Crassatellites* Krüger, Gesch. Urwelt., 2, p. 466.

Type species: *Crassatellites sinuatus* Krüger (designated by Harris 1897).

Subgenus *Crassatellites* s. s. モシホガヒ亞屬

Crassatellites nanus (A. Adams et Reeve) スダレモシホガヒ

Pl. 23, fig. 23.

1850 *Crassatella nana* A. Adams et Reeve, Zool. Samarang, Moll., p. 81, pl. 23, fig. 2.

1882 *Crassatella japonica* Dunker, Index Moll. Mar. Japonici, p. 220.

1886 *Crassatella nana*, Kobelt, Conchyl. Cab., 10 (1a), p. 15, pl. 6, fig. 3.

1886 *Crassatella loebbeckei* Kobelt, Conchyl. Cab., 10 (1a), p. 18, pl. 2, fig. 6; pl. 5, fig. 5.

1917 *Crassatella nana* Lamy, Jour. de Conchyl., 62, p. 227.

1920 *Crassatella heteroglypta* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 39, (6), p. 141, pl. 11, figs. 11, 12.

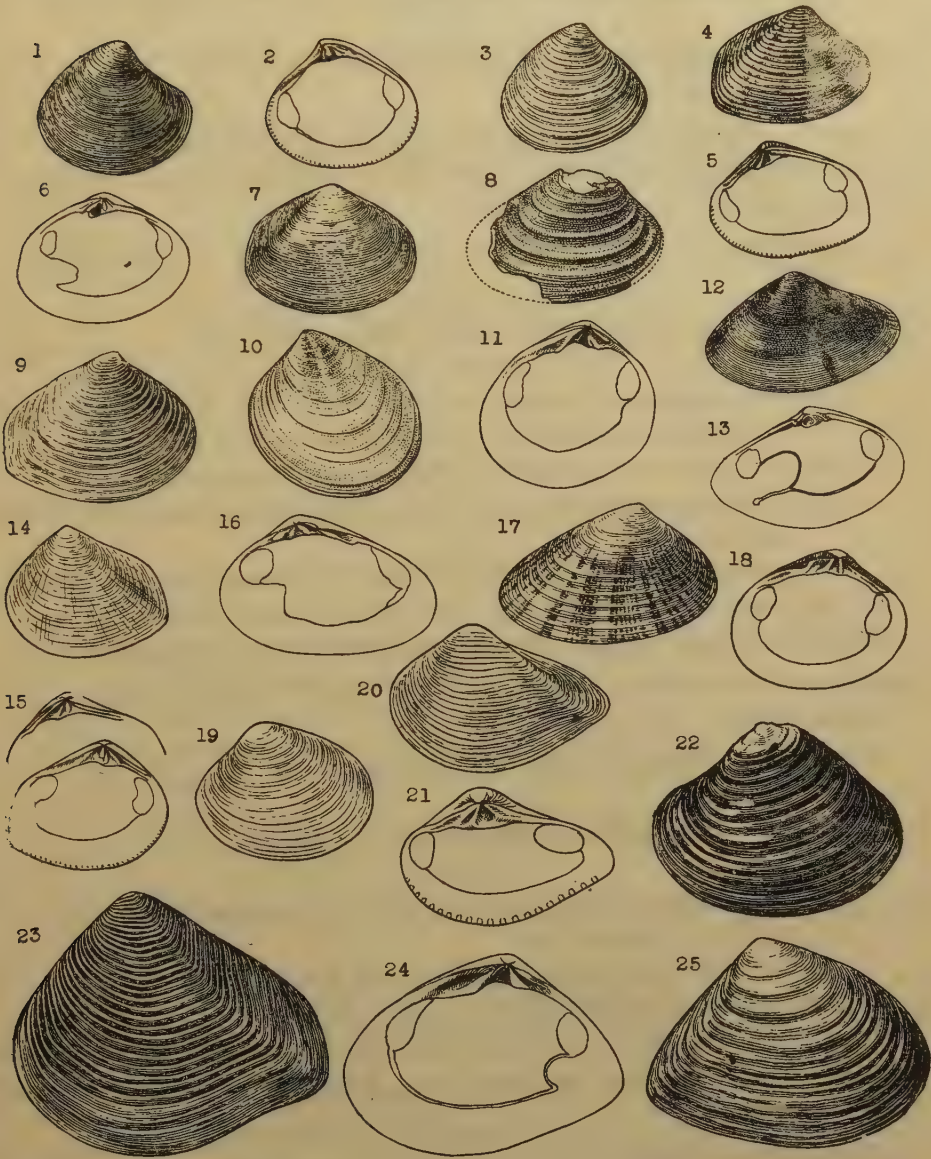
1922 *Crassatella nana* Yokoyama, l. c., 44 (1), p. 164, pl. 13, fig. 8.

1927 *Crassatella nana* Yokoyama, Jour. Fac. Sci. Imp. Univ. Tokyo, (2) 1 (10), p. 434, pl. 49, fig. 11.

Explanation of Plate 23, 第23圖版説明

- Fig. 1. *Astarte (Tridonta) bennettii* Dall コエゾシラガヒ, 15.5×13.8 mm.....p. 163
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 23. *Crassatellites nanus* (A. Adams et Reeve) スダレモシホ, 41.7×36.5 mm...p. 164
 24, 25. *Atactodea striata* (Gmelin) イソハマグリ, 29.7×22.5 mm.....p. 169

Plate 23. Astartidae, Crassatellitidae, Mesodesmatidae.



1928 *Crassatella heteroglypta* Yokoyama, Imp. Geol. Surv. Japan, Rep. 101, p. 88, pl. 16, fig. 3.

1928 *Astarte sulcata* Yokoyama, *l. c.*, p. 88, pl. 9, fig. 6.

1933 *Crassatellites loebbecki* Nomura, Sci. Rep. Tohoku Imp. Univ., (2) 16 (1), p. 66.

1935 *Crassatellites nanus* Otuka, Bull. Earthq. Res. Inst., 13 (4), p. 889, pl. 56, figs. 146, 147.

1936 *Crassatellites nanus* Nomura, Sci. Rep. Tohoku Imp. Univ., (2) 16 (3), p. 239, pl. 11, figs. 6a, b.

Length 41.7 mm., height 36.5 mm., breadth 18.2 mm. (conjoined valves)
(figured specimen collected from Tatsugahama, Wakayama Pref., Honshu).

Type locality: Corean Archipelago.

Distribution: Kyushu; Shikoku; Honshu; Hongkong; Formosa (Pliocene).

Crassatellites heteroglyptus Pilsbry モシホガヒ

Pl. 23, figs. 14, 15.

1889 *Crassatella japonica* Sowerby, Jour. Linn. Soc. London, Zool., 20, p. 399, pl. 25, fig. 19, non Dunker 1882.

1895 *Crassatellites heteroglypta* Pilsbry, Cat. Mar. Moll. Japan, p. 135.

1947 *Crassatellites japonica* Hirase et Kuroda, Illust. Encycl. Fauna Japan, p. 1237, fig. 3517.

1951 *Crassatellites heteroglypta* Is. Taki, Hirase's Handb. Illust. Shells, pl. 21, fig. 4.

1951 *Crassatellites nanus* Habe, Genera Jap. Shells, 2, p. 105, figs. 206, 207.

Length 32.6 mm., height 25.8 mm., breadth 12.9 mm. (conjoined valves)
(figured specimen collected from Sagami Bay by Ryosuke Kawamura).

Type locality: Japan.

Distribution: Kyushu; Shikoku; Honshu.

Crassatellites adamsi (Kobelt) ウスモシホガヒ

Pl. 23, fig. 9.

1850 *Crassatella compressa* A. Adams et Reeve, Voy. Samarang, Moll., p. 82, pl. 83, fig. 10, non Lamarck. 1808.

1886 *Crassatella adamsi* Kobelt, Conchyl. Cab., 10 (1a), p. 26, pl. 7, fig. 13.

? 1886 *Crassatella sublamellata* Kobelt, *l. c.*, p. 15, pl. 7, fig. 11.

Length 19.5 mm., height 15.2 mm., breadth 8.2 mm. (conjoined valves) (figured specimen collected from off Shimane Pref., Honshu: Soyo-maru St. No. 497, 143 m. in depth).

Type locality: Japan.

Distribution: Japan Sea (off Tsushima, : Soyo-maru St. No. 481, 143 m. in depth and Fukui Pref.).

Subgenus *Crassatina* Kobelt 1881 ワタゾコモシホガヒ亞屬

1881 *Crassatina* Kobelt, *Illust. Conchyl.*, **2**, p. 355.

Type species: *Crassatella triquetra* "Sowerby" Reeve (original designation)

Crassatellites (*Crassatina*) *oblongatus* (Yokoyama) ワタゾコモシホガヒ

Pl. 23, figs. 4, 5.

1920 *Crassatella oblongata* Yokoyama, *Jour. Coll. Sci. Imp. Univ. Tokyo*, **39** (6), p. 143, pl. 11, figs. 8, 9.

1922 *Crassatella oblongata* Yokoyama, *I. c.*, **44** (1), p. 164.

Length 10.7 mm., height 8.9 mm., breadth 4.0 mm. (figured specimen collected from Sagami Bay by Ryosuke Kawamura).

Type locality: Koshiha, Yokosuka City (fossil).

Distribution: Honshu (Sagami Bay: Soyo-maru St. No. 249, 229 m. in depth; Suruga Bay: Soyo-maru St. No. 259, 188 m. in depth; off Tanabe, Wakayama Pref.); Shikoku (off Sukumo, Ehime Pref.; Soyo-maru St. No. 327, 216 m. in depth).

Genus *Crenocrassatella* Habe 1951 ヤグラモシホガヒ屬

1951 *Crenocrassatella* Habe, *Genera Jap. Shells*, **2**, p. 105.

Type species: *Crassatella foveolata* Sowerby (original designation).

Crenocrassatella foveolata (Sowerby) ヤグラモシホガヒ

Pl. 23, figs. 20, 21.

1842 *Crassatella sulcata* Reeve, *Proc. Zool. Soc. London*, p. 44, non Lamarck 1801.

1843 *Crassatella sulcata* Reeve, *Conch. Icon.*, sp. 6.

1870 *Crassatella foveolata* Sowerby, *Proc. Zool. Soc. London*, p. 249.

1886 *Crassatella foveolata* Kobelt, *Conchyl. Cab.*, **10** (1a), p. 4, pl. 1, fig. 5.

1886 *Crassatella sulcata* Kobelt, *Conchyl. Cab.*, **10** (1a), p. 23, pl. 8, figs. 1—3.

1917 *Crassatella foveolata* Lamy, *Jour. de Conchyl.*, **62**, p. 223.

1927 *Crassatellites yagurai* Makiyama, *Mem. Coll. Sci. Kyoto Imp. Univ.*, (B) **3** (1), p. 38, pl. 2, figs. 1—4.

1928 *Crassatellites oinouyei* Yokoyama, *Imp. Geol. Surv. Japan, Rep.* 101, p. 89, pl. 13, figs. 1—3.

1928 *Cryptogramma kaneharai* Yokoyama, *I. c.*, p. 80, pl. 8, fig. 5.

1933 *Crassatellites formosanus* Nomura, *Sci. Rep. Tohoku Imp. Univ.*, (2) **16** (1), p. 66, pl. 1, figs. 14, 15.

1933 *Crassatellites sulcatus* Nomura, *I. c.*, p. 67.

1936 *Crassatellites foveolatus* Tan, *Jour. Geol. Soc. Japan*, **43**, pp. 637—640.

1940 *Crassatellites foveolatus* Kuroda, *Taiwan Chigaku Kiji*, **11** (1), p. 25.

1941 *Crassatellites foveolatus* Kuroda, *Mem. Fac. Sci. Agr. Taihoku Imp. Univ.*, **22** (4), p. 158, pl. 12, figs. 71, 72.

1951 *Crenocrassatella foveolata* Habe, Genera Jap. Shells, 2, p. 105, figs. 208, 209.

Length 33.0 mm., height 21.0 mm., breadth 15.0 mm. (figured specimen collected from Kiirun, Formosa and deposited in the Geological Institute, Kyoto University).

Type locality: China

Distribution: South-west Pacific region: Formosa.

Family Mesodesmatidae チドリマスホガヒ科

Genus *Donacilla* Lamarck 1819 チドリマスホガヒ属

1819 *Donacilla* Lamarck, Dict. Sci. Nat., 13, p. 429.

Type species: *Amphidesma donacilla* Lamarck (tautonymy)

Donacilla picta Dunker チドリマスホガヒ

Pl. 23, figs. 16, 17.

1877 *Donacilla picta* Dunker, Malak. Bl., 24, p. 68.

1882 *Donacilla picta* Dunker, Index Moll. mar. Japon., p. 195, pl. 7, figs. 7—10

1951 *Donacilla picta* Is. Taki, Handb. Illust. Shells, pl. 52, fig. 3.

1952 *Donacilla picta* Habe, Gen. Jap. Shells, 3, p. 189, figs. 441, 442.

Length 11.1 mm., height 7.1 mm., breadth 4.2 mm. (figured specimen collected from Yamakawa, Kagoshima Pref., Kyushu).

Type locality: Japan.

Distribution: Okinawa and Amami groups; Kyushu; Shikoku and Honshu.

Genus *Davila* Gray 1853 ナミノコマスホガヒ属

1853 *Davila* Gray, Ann. Mag. Nat. Hist., 2 (11), p. 44.

Type species: *Davila polita* Gray (= *Davila plana* Hanley) (monotypy)

Davila munda (Gould) ナミノコマスホガヒ

Pl. 23, figs. 10, 11.

1851 *Mesodesma munda* Gould, Proc. Boston Soc. Nat. Hist., 3, p. 217 (1850).

1854 *Mesodesma crassula* Reeve, Conch. Icon., sp. 26.

1855 *Mesodesma crassula* Deshayes, Proc. Zool. Soc. London, p. 336 (1854).

1857 *Davila crassula* H. et A. Adams, Gen. Rec. Moll., 2, p. 415, pl. 106, fig. 6.

1898 *Davila crassula* Dall, Trans. Wagner Free Inst. Sci. Phila., 3 (4), p. 913.

1951 *Davila crassula* Is. Taki, Hirase's Handb. Illust. Shells, pl. 52, fig. 4.

1952 *Davila crassula* Habe, Gen. Jap. Shells, 3, p. 190, figs. 447, 448.

Length 18.6 mm., height 17.0 mm., breadth 8.6 mm. (figured specimen collected from Miyako Island, Ryukyu group).

Type locality: Mangsi, Borneo.

Distribution: East Indies; Siam; Philippines; Okinawa and Amami groups.

Genus *Atactodea* Dall 1895 イソハマグリ属

1801 *Paphia* Lamarck, Syst. Anim. s. Vert., p. 120, non Roeding 1798.

1840 *Eryx* Swainson, Treat. Malac., p. 370, non Daudin 1802.

1895 *Atactodea* Dall, Proc. Malac. Soc. London, 1, p. 213.

Type species: *Paphia glabrata* Lamarck (original designation)

Atactodea striata (Gmelin) イソハマグリ

Pl. 23, figs. 24, 25.

1791 *Mactra striata* Gmelin, Syst. Nat., ed. 13, p. 3257.

1791 *Mactra glabrata* Gmelin, l. c., p. 3258.

1854 *Mesodesma striata* Reeve, Conch. Icon., sp. 10.

1899 *Atactodea striata* Hedley, Mem. Austr. Mus., 3, p. 503, fig. 55.

1914 *Mesodesma (Atactodea) striata* Lamy, Jour. de Conchyl., 62, p. 45, pl. 1, fig. 10.

1941 *Mesodesma striata* Hatai, Rec. Mar. Moll. South Sea Islands, pl. 58, figs. 6—8.

1947 *Amphidesma (Atactodea) striatum* Hirase et Kuroda, Illust. Encycl. Fauna Jap., p. 1217, fig. 3457.

1951 *Atactodea striata* Is. Taki, Hirase's Handb. Illust. Shells, pl. 52, fig. 5.

1952 *Atactodea striata* Habe, Gen. Jap. Shells, 3, p. 190, figs. 440, 443.

Length 29.7 mm., height 22.5 mm., breadth 13.2 mm. (figured specimen collected from Tanabe Bay, Wakayama Pref., Honshu).

Type locality:—

Distribution: Australia; Funafuti; East Indies; New Caledonia; Philippines; Formosa; Ryukyu and Amami groups; Kyushu; Shikoku and Honshu.

Genus *Caecella* Gray 1853 クチバガヒ属

1853 *Caecella* Gray, Ann. Mag. Nat. Hist., 2 (11), p. 43.

Type species: *Caecella horstfeldii* Gray (monotypy)

Caecella chinensis (Deshayes) クチバガヒ

Pl. 23, figs. 6, 7.

1855 *Caecella chinensis* Deshayes, Proc. Zool. Soc. London, p. 334 (1854).

1869 *Caecella chinensis* Lischke, Jap. Meer. Conchyl., 1, p. 133, pl. 10, fig. 5, 6.

1920 *Ervilia otsuensis* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 39 (6), p. 109, pl. 17, figs. 21, 22.

1947 *Caecella chinensis* Hirase et Kuroda, Illust. Encycl. Fauna Japan, p. 1217, fig. 3458.

1951 *Caecella chinensis* Is. Taki, Hirase's Handb. Illust. Shells, pl. 52, fig. 6.

Length 22.7 mm., height 18.1 mm., breadth 9.1 mm. (figured specimen collected from Awaji Island, Hyogo Pref., Honshu and deposited in the Geological Institute of Kyoto University)

Type locality : Chinese Seas

Distribution : Cochinchina ; China ; Formosa ; Shikoku ; Kyushu ; Honshu and Hokkaido.

Remarks : *Caecella turgida* Deshayes has been reported from Formosa, but may be an individual variety of this species.

Genus *Spondervilia* Iredale 1930 ハマチドリガヒ屬

1930 *Spondervilia* Iredale, Rec. Austr. Mus., 17, p. 402.

Type species : *Ervilia australis* Angas (original designation).

Spondervilia bisculpta (Gould) ハマチドリガヒ

Pl. 23, figs. 12, 13.

1861 *Ervilia bisculpta* Gould, Proc. Boston Soc. Nat. Hist., 8, p. 28.

1861 *Ervilia livida* Gould, l. c., p. 28.

1862 *Ervilia japonica* A. Adams, Ann. Mag. Nat. Hist., (3) 9 (51), p. 224.

1909 *Ervilia bisculpta* Lynge, Danish Exped. Gulf Siam, Lamellibr., p. 123 (219), pl. 4, figs. 14—16.

1930 *Spondervilia bisculpta* Iredale, Rec. Austr. Mus., 17 (9), p. 402.

1952 *Spondervilia bisculpta* Habe, Gen. Jap. Shells, 3, p. 191, figs. 444—446.

Length 5.2 mm., height 3.5 mm., breadth 2.2 mm. (figured specimen collected from Kagoshima City, Kyushu).

Type locality : Kagoshima, Kyushu.

Distribution : Gulf of Siam ; Philippines ; Kyushu and Honshu.

Family Laternulidae ソトホリガヒ科

Genus *Laternula* Röding 1798 ソトホリガヒ屬

1798 *Laternula* Röding, Mus. Bolt., p. 155.

1811 *Auriscalpium* Megerle von Mühlfeld, Ges. Nat. Fr. Berlin, Mag., 5 (1), p. 46.

1816 *Anatina* Bosc, Nouv. Dict. d'Hist. nouv. ed., 1, p. 492.

1848 *Butor* Gistel, Nat. Thierr., p. 172.

1928 *Butorella* Strand, Arch. Naturg., 92, A8, p. 39 (1926).

Type species : *Laternula anatina* Röding = *Solen anatinus* Linné (designated by Gray 1847)

Subgenus *Laternula* s. s. ソトホリガヒ亞屬

Shell with lithodesma.

1. *Laternula truncata* (Lamarck) ヒロクチソトホリガヒ

Text-fig. 1.

1818 *Anatina truncata* Lamarck, Anim. s. Vert., 5, p. 463.

1842 *Anatina rostrata* Sowerby, Conch. Man., ed. 2, pl. 3, fig. 69.

1863 *Anatina truncata* Reeve, Conch. Icon., sp. 11.

1925 *Anatina truncata* Lamy, Bull. Mus. Hist. Nat. Paris, 3, p. 373

1934 *Anatina rostrata* Lamy, Jour. de Conchyl., 78, p. 162.

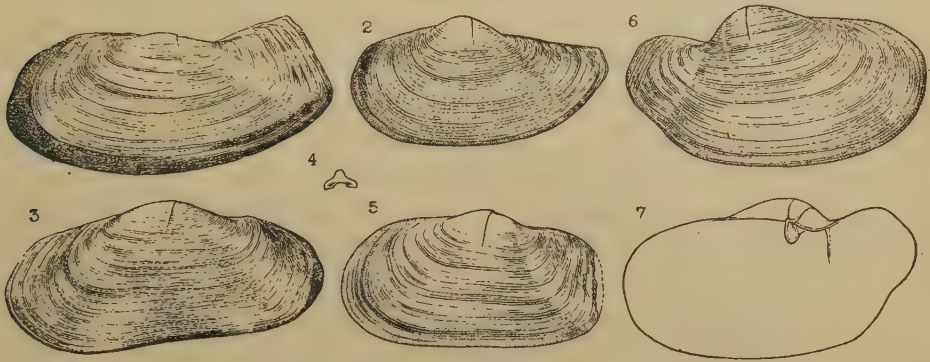
1934 *Anatina truncata* Lamy, l. c., pl. 1, fig. 8.

1941 *Laternula rostrata* Kuroda, Mem. Fac. Sci. Agr. Taihoku Imp. Univ., 22 (4), p. 173, pl. 14, fig. 48.

Length 49.2 mm., height 22.5 mm., breadth 15.2 mm. (figured specimen collected from Takao, Formosa and deposited in the Geological Institute, Kyoto University)

Type locality: St. Pierre and St. Francois Islands, North Australia.

Distribution: South-west Pacific regions; Formosa and Miyako Island, Ryukyu group.



- Text-fig. 1. *Laternula (Laternula) truncata* (Lamarck) ヒロクテソトホリガビ.
2. *Laternula (Laternulina) impura* (Pilsbry) コオキナガビ.
3. *Laternula (Laternula) limicola* (Reeve) (forma *kamakurana* Pilsbry) ソトホリガビ.
4. *Lithodesma* of the same ソトホリガビの殻帯.
5. *Laternula (Laternula) limicola* (Reeve) ソトホリガビ.
6, 7. *Laternula (Laternulina) flexuosa* (Reeve) オキナガビ.

2. *Laternula limicola* (Reeve) ソトホリガビ

Text-figs. 3, 4, 5.

1863 *Anatina limicola* Reeve, Conch. Icon., sp. 27.

1895 *Anatina kamakurana* Pilsbry, Cat. Mar. Moll. Japan, p. 138, pl. 3, figs. 2, 3.

1928 *Anatina peichiliensis* Grabau et King, Shells of Peitaiho, 2, ed., p. 193, pl. 7, fig. 58.

Length 37.7 mm., height 20.7 mm., breadth 15.3 mm. (figured specimen collected from Kojima Bay, Okayama Pref., Honshu).

Length 48.4 mm., height 21.4 mm., breadth 15.9 mm. (figured specimen collected from the Urado Bay, Kochi Pref., Shikoku).

Type locality: Japan.

Distribution: China; Kyushu; Shikoku; Honshu; Hokkaido and Sagalien.

Subgenus *Laternulina* Habe 1952 オキナガヒ亞屬

1952 *Laternulina* Habe, Genera Jap. Shells, 3, p. 266.

Type species: *Anatina japonica* Lischke (original designation)

Shell without lithodesma.

Laternula (Laternulina) flexuosa (Reeve) オキナガヒ

Text-figs. 6, 7.

1863 *Anatina flexuosa* Reeve, Conch. Icon., sp. 2.

1872 *Anatina japonica* Lischke, Malak. Bl., 19, p. 107.

1874 *Anatina japonica* Lischke, Jap. Meer. Conchyl., 3, p. 101, pl. 9, figs. 7—10.

1934 *Anatina japonica* Lamy, Jour. de Conchyl., 78, p. 155.

1951 *Laternula japonica* Is. Taki, Handb. Illust. Shells, pl. 20, fig. 1.

1952 *Laternula flexuosa* Habe, Genera Jap. Shells, 3, p. 267, fig. 707.

Length 47.3 mm., height 25.6 mm., breadth 19.7 mm. (figured specimen collected from Wakayama Pref., Honshu).

Type locality: Japan.

Distribution: Kyushu; Shikoku and Honshu.

Remarks: *Anatina cumingii* Reeve from the Philippines and *Anatina siphonata* Reeve from Borneo are closely allied to this species.

Laternula (Laternulina) impura (Pilsbry) コオキナガヒ

Text-fig. 2.

1901 *Anatina impura* Pilsbry, Proc. Acad. Nat. Sci. Phila., 53, pp. 208, 402, pl. 19, fig. 9.

Length 38.7 mm., height 19.8 mm., breadth 14.6 mm. (figured specimen collected by Korokuro Nakamigawa).

Type locality: Kamakura, Kanagawa Pref., Honshu.

Remarks: This species approaches to *L. limicola* (Reeve) superficially, but has no lithodesma in front of chondrophore.

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Xenophoridae, Columbariidae, Caecidae

No. 23.

日本産クマサカガヒ科・イトグルマガヒ科

ミチンギリギリツツガヒ科

波部 忠重

Xenophoridae, Columbariidae and Caecidae in Japan

by

Tadashige HABE

Family Xenophoridae クマサカガヒ科

Genus *Xenophora* Fischer von Waldheim 1807 クマサカガヒ屬

1807 *Xenophora* Fischer von Waldheim, Mus. Demidoff, Moscou, 3, p. 213.

1810 *Phorus* Montfort, Conchyl. Syst., 2, p. 159.

1851 *Xenophorus* Philippi, Zeitschr. f. Malak., p. 44.

Type species: *Trochus conchyliophorus* Born (designated by Sacco 1896).

1. *Xenophora solarioides* (Reeve) クルマクマサカガヒ

Textfig. 11.

1845 *Phorus solarioides* Reeve, Conch. Icon., sp. 8.

1850 *Phorus solarioides* A. Adams et Reeve, Moll. Voy. Samarang, p. 50, pl. 17, fig. 6.

1851 *Xenophora solarioides* Philippi, Conch. Cab., 2 (3), p. 346, pl. 46, fig. 6.

1854 *Xenophora solarioides* H. et A. Adams, Gen. Rec. Moll., 1, p. 363, pl. 40, figs. 2a, b.

1879 *Xenophora solarioides* Fischer, Icon. Coq. viv., 11, p. 447, pl. 44, fig. 3.

1886 *Xenophora solarioides* Tryon, Man. Conch., 8, p. 159, pl. 44, fig. 77.

1902 *Xenophora solarioides* Uchiyama, Zool. Mag. (Japan), 14, p. 12, pl. 22, fig. 1.

Height 12.7 mm., breadth 22.7 mm. (examined specimen collected from Baten, Okinawa Island, Ryukyu, by Tokubei Kuroda).

Type locality: St. Nicolas, Zebu, Philippines.

Distribution: East Indies; Philippines; Formosa and the Ryukyus.

Xenophora pallidula (Reeve) クマサカガヒ

Textfigs. 12, 13.

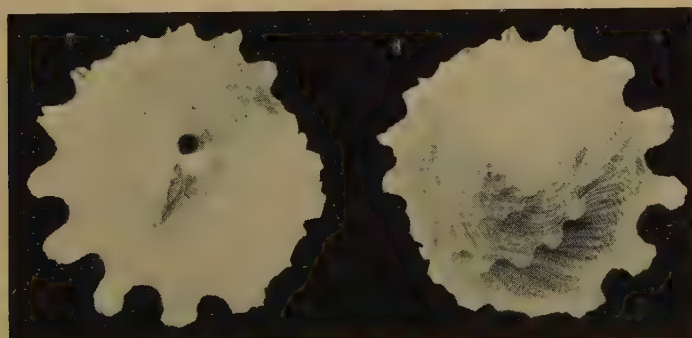
1843 *Phorus pallidulus* Reeve, Conch. Icon., sp. 4.

1843 *Phorus pallidulus* Reeve, Proc. Zool. Soc. London, p. 162 (1842).

- 1851 *Xenophora pallidula* Philippi, Conch. Cab., 2 (3), p. 347, pl. 48, fig. 2.
 1874 *Xenophora pallidula* Lischke, Jap. Meer. Conchyl., 3, p. 56, pl. 3, figs. 1, 2, 3.
 1879 *Xenophora pallidula* Fischer, Icon. Coq. viv., 11, p. 444, pl. 54.
 1886 *Xenophora pallidula* Tryon, Man. Conch., 8, p. 160, pl. 44, fig. 79.
 1902 *Xenophora pallidula* Uchiyama, Zool. Mag. (Japan), 14, p. 2, pl. 22, figs. 4, 5, 6.
 1947 *Xenophora pallidula* Hirase et Kuroda, Illust. Encycl. Fauna Japan (revised edition),
 p. 1139, fig. 3236.
 1951 *Xenophora pallidula* Is. Taki, Hirase's Handb. Illust. Shells, pl. 89, fig. 2.



Textfigs. 1. 2. *Trochotugurium giganteum* (Schepman) ダイワウキヌガサガヒ $\times \frac{2}{3}$



Textfigs. 3, 4, 5. *Xenophora konoi* Habe チリメンクマサカガヒ, 6. *Xenophora corrugata* (Reeve) シワクマサカガヒ, 7, 8. *Onustus exutus* (Reeve) キヌガサガヒ $\times \frac{1}{2}$.

Height 46.1 mm., breadth 83.2 mm. (figured specimen collected from Tosa Bay, Shikoku by Akibumi Teramachi).

Type locality: Coast of Japan.

Distribution: Indian Ocean; East Indies; Ryukyu and Amami groups; Kyushu; Shikoku and Honshu.

Xenophora corrugata (Reeve) シワクマサカガヒ

Textfig. 6.

1843 *Phorus corrugatus* Reeve, Conch. Icon., sp. 6.

1843 *Phorus corrugatus* Reeve, Proc. Zool. Soc. London, p. 163 (1842).

1851 *Xenophora corrugata* Philippi, Conch. Cab., 2 (3), p. 346, pl. 48, fig. 1.

1879 *Xenophora corrugata* Fischer, Icon. Coq. viv., 11, p. 441, pl. 8.

1887 *Xenophora corrugata* Tryon, Man. Conch., 8, p. 159, pl. 45, figs. 81, 82.

1902 *Xenophora corrugata* Uchiyama, Zool. Mag. (Japan), 14, p. 2, pl. 22, figs. 2, 3.

Height 32.9 mm., breadth 41.8 mm. (figured specimen collected from off Wakayama Pref., Honshu by Seiichiro Kinoshita).

Type locality: ———.

Distribution: Indian Ocean; East Indies; Ryukyu group; Kyushu; Shikoku and off Wakayama Pref., Honshu.

Xenophora konoï new species チリメンクマサカガヒ

Textfigs. 3, 4, 5.

Shell medium in size, conical, rather thin, more or less umbilicate, yellowish white; whorls about 8, embryonic whorls smooth and polished; succeeding whorls convex, suture very deep; surface obliquely and distantly corrugated and with many undulating striae which are crossed by weak growth lines, and agglutinated along the suture with numerous small pebbles and shells and coronated on the peripheral keel of the last whorl; the undersurface concave, with many granular spiral cords; aperture widely ovate, strongly oblique; outer margin simple and sharp; columellar margin white, thickened, reflexed and dilated over the umbilicus; a thin layer of enamel on the parietal wall connects the upper and columellar margins; umbilicus obliquely opened and broadly covered by the dilation of the columellar callus.

Operculum thin, corneous, nucleus lateral, with the closely set lamellating striae.

Height 52.7 mm., breadth 54.8 mm. (figured type specimen collected by Michinori Kôno).

Type locality: Bungo Channel between Kyushu and Shikoku.

Remarks: In general aspects the nearest ally of this splendid species may

be *Xenophora tenuis* Fulton which differs by its closed umbilicus, thinner shell structure with less higher spire, finer undulating sculpture, and the absence of granular spiral cords on the undersurface.

Xenophora tenuis Fulton ウスクマサカガヒ

Textfigs. 9, 10.

1934 *Xenophora tenuis* S. Hirase, Coll. Jap. Shells, p. 57, pl. 89, fig. 3 (name and figure only).

1938 *Xenophora tenuis* Fulton, Proc. Malac. Soc. London, 23, p. 56, pl. 3, fig. 5.

1939 *Xenophora tenuis* Fulton, l. c., p. 236.

1951 *Xenophora tenuis* Is. Taki, Hirase's Handb. Illust. Shells, pl. 89, fig. 3.

Height 29.0 mm., breadth 40.2 mm. (figured specimen collected from Tosa Bay, Shikoku by A. Teramachi).

Type locality: Prov. Kii (=Wakayama Pref.), Honshu.

Distribution: Tosa Bay, Shikoku and off Wakayama Pref., Honshu.

Xenophora calculifera (Reeve) オホクマサカガヒ

Textfigs. 16, 17.

1841 *Trochus sinensis* Philippi, Funfter Jahrb. Ves. Naturk. Kassel, p. 8 (non Gmelin 1791).

1843 *Phorus calculiferus* Reeve, Conch. Icon., sp. 1.

1843 *Phorus calculiferus* Reeve, Proc. Zool. Soc. London, p. 162 (1842).

1851 *Xenophora sinensis* Philippi, Conch. Cab., 2 (3), p. 348, pl. 49, fig. 1.

1879 *Xenophora calculifera* Fischer, Icon. Coq. viv., 11, p. 438, pl. 7, fig. 1.

1886 *Xenophora calculifera* Tryon, Man. Conch., 8, p. 159, pl. 44, figs. 75, 76.

1931 *Xenophora calculifera* Kuroda, Venus, 2 (6), p. 319, fig. on the title page.

Height 40.0 mm, breadth 89.0 mm. (figured specimen collected from Wakayama Pref., Honshu by S. Kinoshita).

Type locality: ———.

Distribution: East Indies; China; Formosa and Wakayama Pref., Honshu.

Genus *Trochotugurium* Sacco 1896

1896 *Trochotugurium* Sacco, Moll. Terr. Terz. Piemonte Liguria, 20, p. 27.

Type species: *Tugurium* (*Trochotugurium*) *borsoni* "Bellardi" Sismonda.

Trochotugurium giganteum (Schepman) ダイワウキスガサガヒ

Textfigs. 16, 17.

1909 *Xenophora gigantea* Schepman, Siboga Exped. Monogr. 49b (Prosobr. 2), p. 204, pl. 13, fig. 1.

Height 67.6 mm., breadth 131.5 mm. (figured specimen collected from Tosa Bay, Shikoku by A. Teramachi).

Type locality: Flores Sea (521 m. in depth).

Distribution: East Indies; Shikoku and off Wakayama Pref., Honshu.

Genus *Haliphoetus* Fischer 1879 カヂトリグルマガヒ属

1879 *Haliphoetus* Fischer, Icon. Coq. viv., 11, p. 450.

Type species: *Trochus solaris* Linné (monotypy)



Textfigs. 9, 10. *Xenophora tenuis* Fulton ウスグマサカガヒ, 11. *Xenophora solarioides* (Reeve) クルマクマサカガヒ (after Reeve 1845), 12, 13. *Xenophora pallidula* (Reeve) クマサカガヒ, 14. *Haliphoetus solaris* (Linné) カヂトリグルマ (after Illust. Ency. Fauna Japan 1947), 15. *Onustus indicus* (Gmelin) タイワンキヌガサ (after Reeve 1843).

Haliphoebus solaris (Linné) カザトリグルマガヒ

Textfig. 14.

1767 *Trochus solaris* Linné, Syst. Nat., ed. 12, p. 1229.

1843 *Phorus solaris* Reeve, Conch. Icon., sp. 5.

1843 *Phorus solaris* Reeve, Proc. Zool. Soc. London, p. 161 (1842).

1879 *Xenophora solaris* Fischer, Icon. Coq. viv., 11, p. 428, pl. 3, fig. 1.

1886 *Xenophora solaris* Tryon, Man. Conch., 8, p. 162, pl. 47, figs. 92, 93.

1909 *Xenophora* (*Onustus*) *solaris* Schepman, Siboga Exped., 49b, p. 205.

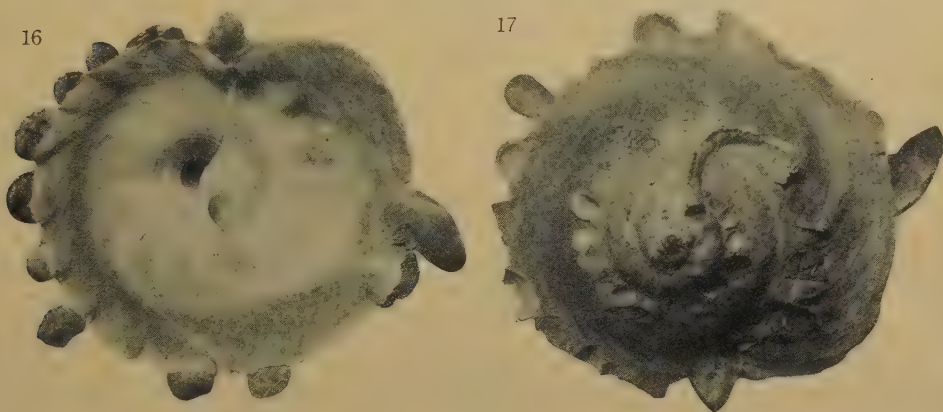
1947 *Tugurium* (*Haliphoebus*) *solaris* Kuroda, Illust. Encycl. Fauna Japan, (rev. ed.), p. 1139, fig. 3238.

Height 38.0 mm., breadth 64.3 mm. (excluded the length of spines) (examined specimen probably from China seas).

Type locality: East Indies.

Distribution: Indian Ocean; East Indies; South China Sea.

Remarks: This species has never been reported from the seas around Japan.



Textfigs. 16, 17. *Xenophora calculifera* (Reeve) オホクマサカ (after Kuroda 1931)

Genus *Onustus* Swainson 1840 キヌガサガヒ属

1840 *Onustus* Swainson, Treat. Malac., p. 352.

1879 *Tugurium* Fischer, Icon. Coq. viv., 11, p. 450.

Type species: *Onustus indicus* (Cmelin) (= *Trochus indicus* Cmelin) (designated by Gray 1847).

Onustus exutus (Reeve) キヌガサガヒ

Textfigs. 7, 8.

1843 *Phorus exutus* Reeve, Conch. Icon., sp. 7.

1843 *Phorus exutus* Reeve, Proc. Zool. Soc. London, p. 162 (1842).

1850 *Phorus exutus* A. Adams et Reeve, Moll. Voy. Samarang, p. 50, pl. 17, fig. 7.

1851 *Xenophora exuta* Philippi, Conch. Cab., 2 (3), p. 348, pl. 48, fig. 4.

1854 *Onustus exutus* H. et A. Adams, Gen. Rec. Moll., 1, p. 362, pl. 40, figs. 1a, b.

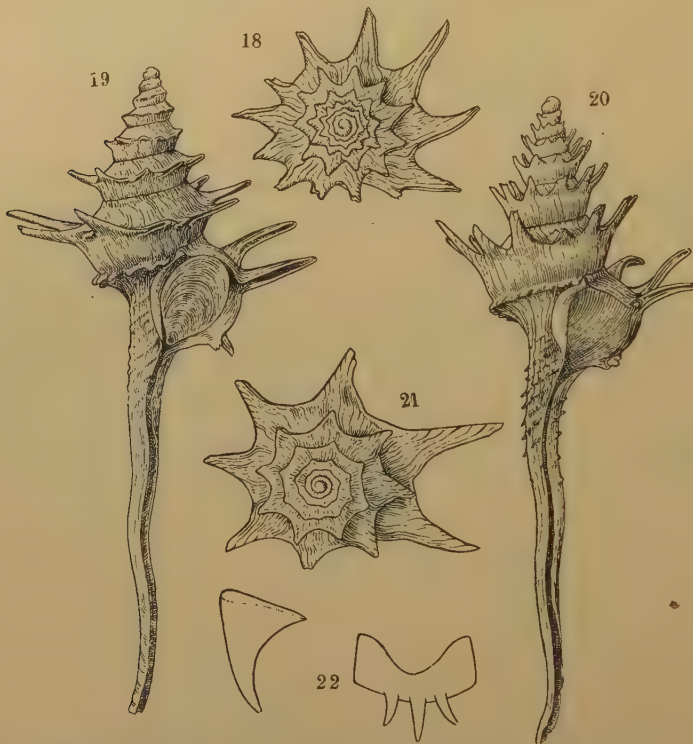
- 1876 *Xenophora exuta* Fischer, Icon. Coq. viv., 11, p. 430, pl. 22, figs. 1, 2.
 1886 *Xenophora exuta* Tryon, Man. Conch., 8, p. 161, pl. 46, figs. 90, 91.
 1902 *Xenophora exuta* Uchiyama, Zool. Mag. (Japan), 14, p. 2, pl. 22, figs. 7, 8, 9.
 1915 *Xenophora exuta* Y. Hirase, Illust. Thousand Shells, 2, pl. 26, fig. 122.
 1947 *Tugurium exutum* Hirase et Kuroda, Illust. Encycl. Fauna Japan (rev. ed.), p. 1139, fig. 3237.

1951 *Xenophora exuta* Is. Taki, Hirase's Handb. Illust. Shells, pl. 89, fig. 4.

Height 35.3 mm., breadth 74.7 mm. (figured specimen collected from Kushi-moto, Wakayama Pref., Honshu by Chikage Morishima).

Type locality: China.

Distribution: East Indies; China; Formosa; Kyushu; Shikoku and Honshu.



Textfigs. (18) 19. *Columbarium fagoda* forma *stellata* Habe メウジョウイトグルマ, 20, (21) *Columbarium fagoda* (Lessen) イトグルマガヒ, 22. Radula of the same イトグルマの歯舌.

Onustus indicus (Cmelin) タイワンキヌガサガヒ

Textfig. 15.

- 1791 *Throchus indicus* Gmelin, Syst. Nat., ed 13, p. 3575.
 1843 *Phorus indicus* Reeve, Conch. Icon., sp. 2.
 1851 *Xenophorus helvaceus* Philippi, Zeitschr. f. Malak., p. 44.
 1851 *Xenophora helvacea* Philippi, Conch. Cab., 2 (3), p. 343, pl. 47, fig. 1.

- 1851 *Xenophora indica* Philippi, *l. c.*, p. 344, pl. 47, figs. 4, 5.
 1851 *Xenophora wagneri* Philippi, *l. c.*, p. 345, pl. 47, figs. 2-3.
 1859 *Onustus indicus* Chenu, *Man. de Conchyl.*, 1, p. 323, figs. 2314-2315.
 1879 *Xenophora helvacea* Fischer, *Icon. Coq. viv.*, 11, p. 432, pl. 53.
 1879 *Xenophora indica* Fishher, *l. c.*, p. 433, pl. 9 fig. 1.
 1886 *Xenophora indica* Tryon, *Man. Conch.*, 8, p. 161, pl. 46, figs. 92, 93.
 1886 *Xenophora helvacea* Tryon *l. c.*, p. 162, pl. 47, fig. 96.
 1941 *Xenophora (Tugurium) helvacea* Kuroda, *Mem. Fac. Sci. Ag. Taihoku Imp. Univ.*, 22 (4), p. 96.

Breadth 51.5 mm. (after Reeve 1843).

Type locality: India.

Distribution: Indian Ocean; East Indies; China and Formosa.

Family Columbariidae イトグルマガヒ科

Genus *Columbarium* v. Martens 1881 イトグルマガヒ属

1881 *Columbarium* v. Martens, *Conch. Mittheil.*, 2, p. 105.

Type species: *Pleurotoma (Columbarium) spinicincta* v. Martens (by Clench 1944):

Columbarium pagoda (Lesson)—イトグルマガヒ

Textfigs. 18-22.

- 1834 *Fusus pagodus* Lesson, *Illustr. de Zool.*, 14, pl. 40.
 1839 *Fusus japonicus* Gray, *Zool. Beechey's Voy. Moll.*, p. 115.
 1840 *Fusus pagodus* Kiener, *Icon. Coq. viv.*, *Fusus* p. 7, pl. 5, fig. 2.
 1847 *Fusus pagoda* Reeve, *Conch. Icon.*, sp. 32.
 1880 *Fusus diadema* Sowerby, *Thes. Conch.*, 4, p. 79, pl. 410, fig. 53.
 1881 *Fusus pagoda* Kobelt, *Conch. Cab.*, 3 (3b), p. 159, pl. 49, figs. 4, 5.
 1881 *Fusus pagoda* Tryon, *Man. Conch.*, 3, p. 51, pl. 32, fig. 86.
 1882 *Fusus pagoda* Dunker, *Index Moll. Mar. Jap.*, p. 13, pl. 1, figs. 8, 9, 10.
 1931 *Columbarium pagodus* Thiele, *Handb. syst. Weicht.*, 2, p. 289, fig. 312.
 1944 *Columbarium pagodus* Clench, *Johnsonia*, 1 (15), p. 4, fig. 2.
 1947 *Columbarium pagoda* Hirase et Kureda, *Illustr. Encycl. Fauna Jap.*, p. 1115, fig. 3166.

1951 *Columbarium pagoda* Is. Taki, *Hirase's Handb. Illustr. Shells*, pl. 108, fig. 1.

Length 84.8 mm., breadth 34.6 mm. (typical form) (figured specimen collected from Kii (=Wakayama Pref.), Honshu by A. Teramachi).

Length 86.8 mm., breadth 42.8 mm. (*stellata* form) (figured specimen collected from Tosa (=Kochi Pref.), Shikoku by A. Teramachi).

Type locality: Japan?

Distribution: Kyushu; Shikoku and Honshu.

Remarks: Varietal name *stellata* has been fixed for those individuals with larger shell, fewer spines of larger size which radiate in rather horizontal manner, but there exist all kinds of the transitional forms between those two, and the author dared not them to divide into two.

Family Caecidae ミデンギリギリツツガヒ科

Genus *Caecum* Fleming 1813 ミデンギリギリツツガヒ属

1813 *Caecum* Fleming, Edinb. Encycl., 7, p. 67.

1857 *Anellum* Carpenter, Cat. Mazatlan Moll., p. 319.

Type species: *Dentalium trachea* Montagu (designated by Gray 1847).

Caecum gracile Gould ミデンギリギリツツガヒ

Textfig. 23.

1861 *Coecum gracile* Gould, Proc. Boston Soc. Nat. Hist., 7, p. 407.

1868 *Caecum gracile* A. Adams, Ann. Mag. Nat. Hist., (4) 2 (11), p. 364

Length 2.8 mm., diameter of aperture 0.7 mm. (figured specimen collected from Takenohama, Hyogo Pref., Honshu by the late Mr. Wasaburo Yagura).

Type locality: China Seas.

Distribution: China; Goto Islands, Kyushu; Tanabe Bay, Wakayama Pref., and Takenohama, Hyogo Pref. (Prov. Tajima), Honshu.



23. *Caecum gracile* Gould ミデンギリギリツツガヒ×6

24. *Brochina glabella* A. Adams ミデンツツガヒ×6

Genus *Brochina* Gray 1857 ミデンツツガヒ属

1857 *Brochina* Gray, Guide Syst. Distr. Moll. Brit. Mus., 1, p. 101.

Type locality: *Brochina glabra* (= *Dentalium glabrum* Montagu) (monotypy).

Brochina glabella A. Adams ミデンツツガヒ

Textfig. 24.

1868 *Brochina glabella* (Carpenter MS.) A. Adams, Ann. Mag. Nat. Hist. (4) 2 (11), p. 365.

1922 *Caecum vitreum* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, 44 (1), p. 76, pl. 3, fig. 18.

Length 2.8 mm diameter of aperture 0.8 mm. (figured specimen collected

from Awaji, Hyogo Pref., Honshu and deposited in the Zoological Institute of Kyoto University).

Type locality: Tanabe Bay (here selected).

Distribution: Tanabe Bay, Wakayama Pref.; Awaji Island; Takenohama (Prov. Tajima) and Akashi, Hyogo Pref. and Misaki, Kanagawa Pref., Honshu.

Tugalina radiata n. gen. et n. sp. ヒノデサルアハビ

Shell medium in size, thin, ornamented with 12 or 13 brown broad radial patterns on the yellowish ground, almost flattened, the height being only 12 to 20% of the length of the shell, apex situated at the posterior third of the shell length, somewhat raised and turned posteriorly; all radial ribs broad and low, variable in size, thus the shell looks apparently smooth, but a rib running from the apex to the frontal margin is somewhat raised as an anal fasciole; fissure marked by only a small excavation at the terminal of the frontal rib; margin obsoletely crenulated; concentric growth threads irregularly developed, cross the radial ribs, forming shallow excavations between them.

Length 14.5 mm., breadth 10.2 mm., height 1.7 mm. (type specimen)

Length 10.5 mm., breadth 8.0 mm., height 2.0 mm. (paratype specimen).

Type locality: Okinawa, Ryukyus.

Remarks: This new genus differs from *Tugali* in having the rather flattened and thin shell on which the ribs are radiating in irregular sizes.

Laeviemarginula membranacea n. gen. et n. sp.

Shell rather large, attaining about 20 mm. in length, thin, semitranslucent, membranous, low conical; aperture abruptly expanding toward the margin, its height being a little shorter than one-fourth of the length of shell; aperture ovate, somewhat narrowed in front; apical whorls smooth and polished, reduced to a small pointed hook, its location being somewhat posterior to the center of the shell; anterior slope slightly convex and the posterior slope slightly concave; anal fasciole narrow and roundly raised, with the weak transverse lamellae which are distinctly placed; fissure also narrow, one-fourth the length of the anterior slope and bordered with two upturned edges; sculpture consists of about 15 primary ribs which are very low and prickled on their tops distantly, in addition to them there occur very weak secondary ribs, and between primary and secondary ribs third series of still weaker ribs, only visible under the lens; numerous concentric minute threads cross the radial ribs and

threads all over and divide the spaces between them into very minute pits under the lens; the obsolete crenulations on the margin caused by the terminations of the primary ribs being considerably large.

Length 19.8 mm., breadth 13.6 mm., height 4.7 mm. (type specimen).

Type locality: Okinawa, Ryukyus.

Remarks: This is very unlike the all known *Emarginulids* in having the semitranslucent thin shell with the radiating prickled low ribs.

Diodora semilunata n. sp. ミカヅキテンガイ

Shell rather small in size, not exceeding 8.5 mm. in length, solid, pale yellow, in some specimens irregularly ornamented with the blackish spots, conical in shape; margin arcuate; the posterior slope convex and longer than the anterior one which is straight or slightly convex; aperture ovate, slightly narrowed posteriorly; both lateral margins arcuately raised, so that in the side view the shell is semilunate in shape; apex situated at a little below the summit anteriorly and perforate like a small key hole; primary radial ribs about 25 in number, intercalated by secondary ribs between each two of them and also by tertiary series of them near the margin; numerous concentric cords cross the ribs giving the shell a lattice like appearance; margin crenulated by the terminations of ribs; interior of shell white and polished.

Length 7.8 mm., breadth 5.8 mm., height 4.0 mm. (type specimen)

Length 8.2 mm., breadth 5.8 mm., height 3.8 mm. (paratype specimen)

Length 8.2 mm., breadth 6.2 mm. height 4.0 mm. (paratype specimen)

Type locality: Okinawa, Ryukyus.

Remarks: This new species is closely related to *Diodora arcuata* from the West Indies in the general appearance, but the sculpture is different, being reticulated in the former and being scaly in the latter.

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On Two Interesting Species of Epizoic Barnacle
Acasta from Japan

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(Received May 13, 1952)

I have already pointed out (HIRO, 1937 b), that *Acasta* among the Cirripedia is a rather large genus showing adaptive changes of structures consequent upon life in sponges or coelenterates. In this respect the following two species of *Acasta* may provide interesting examples to show the tendencies of modification divergent to the extreme. The material consists of two species, one of which *Acasta coriobasis* BROCH was obtained by Mr. Tukizi SATO from a tetraxon sponge and the other *Acasta alcyonicola* n. sp. obtained by Mr. Torao YAMAMOTO from Nephtheid alcyonarians.

I am greatly indebted to the gentlemen mentioned above for placing the material at my disposal.

Acasta coriobasis BROCH

(Fig. 1)

Acasta coriobasis, BROCH, 1947, pp. 25-29, figs. 6 & 7.

Acasta satoi (MS), UTINOMI, 1949, p. 69. (*nomen nudum*)

Locality. Nômi-sima, Hiroshima Bay. Shore. Six specimens embedded in a tetraxon sponge. October 1934, T. SATO *leg.*

BROCH (1947) has described from the mouth of Bassac, at Indochinese coast, a barnacle living in a large and soft sponge and named it *Acasta coriobasis* on account of the leathery texture of the basal cup. The present specimens, which I had intended to describe as a new species, before I saw BROCH's paper, evidently belong to the same species, although some insignificant differences are found in minor details.

All the specimens are very large, measuring in millimeters as follows :

Carino-rostral diameter	12.7	10.0	9.4	9.0	10.0
Height	17.7	16.2	12.2	14.2	—

The first one is probably of the largest size among all known species of *Acasta*, as can be deduced from earlier records.

The compartments are white and tinged with reddish purple hue towards the apices and their surface is delicately striped horizontally ; this is also the

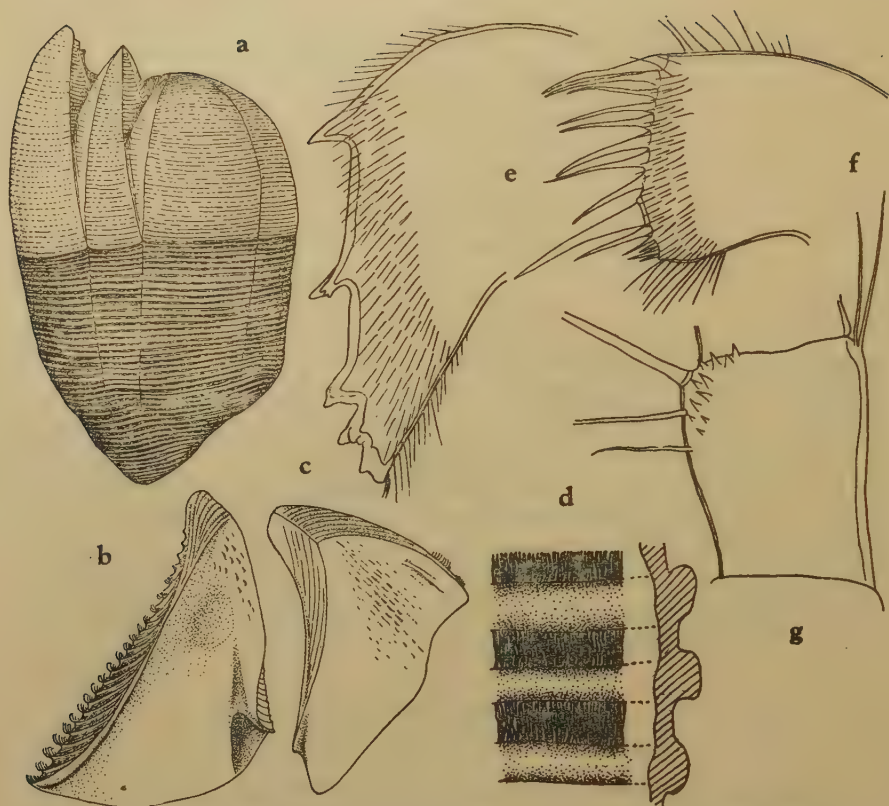


Fig. 1. *Acasta coriobasis* BROCH. a perfect specimen. $\times 4$; b inner side of scutum. $\times 8$; c inner side of tergum. $\times 8$; d a portion of basal cup and its cross section. $\times 55$; e mandible. $\times 65$; f maxilla I. $\times 65$; g median segment of anterior ramus of cirrus IV. $\times 150$.

case with the radii and alae. All the plates are completely calcified and rather loosely connected to one another. Carinal latus is about 1 to 2 mm wide and $1/3$ to $1/4$ as broad as lateral compartment. The former plate has well-developed radii and alae, while the latter has narrower alae which are almost concealed under the very narrow radii of strongly arched rostrum. In this respect my specimens differ greatly from BROCH's type, a difference which may be due to condition of embedding in the host. The sheath occupies the area a little more than half as long as the wall and its basal edge is free from the wall by a deep excavation. There is no longitudinal rib on the inside of the wall. The orifice is roughly triangular in outline because of almost concrescence of the apices of rostrum and lateral compartments on the same level.

The basal cup, which is deeper than the height of compartments in my specimens, is yellowish white, feebly calcified and rather leathery in texture, as mentioned by BROCH. It shows a peculiar basket-like structure with alternating fully calcified ridges and delicate weave-like depressions parallel with the edge of the cup (Fig. 1d). In addition six radiating stripes run downwards from the points, where the six different compartments adjoin each other.

Scutum very thick, concave outside, having close growth ridges traversed by more than six conspicuous radiating grooves. Outside it is covered by the cuticle fringed with yellow hairs along the growth ridges. Inside there is a distinct adductor ridge separated from the articular ridge by a longitudinal shallow groove. The pit for adductor muscle is distinct, though not deep; the pit for lateral depressor muscle is very deep and distinctly circumscribed.

Tergum thinner and wider than scutum, peaked, flat and marked with plain, indistinct growth ridges. The spur is short and truncated, about two-thirds as broad as the plate. The inside is feebly sculptured but roughened with many small tubercles. Crests for depressor muscles are indistinct.

Mouth-parts: Labrum with a minute tooth on each side of a median deep notch, although BROCH does not recognize its presence.

Mandible with five teeth, the second to fourth are bifid, and the fifth rudimentary.

Maxilla I with almost straight frontal edge without any notch. A row of six spines of almost the same length is arranged below the upper two larger spines, and on the lower part again a conspicuously large and a small spines. The lower angle is armed with about five spinules but not acute.

Cirri of a dissected specimen show the following numbers of segments:

I	II	III	IV	V	VI
$\overbrace{19 \quad 9}$	$\overbrace{10 \quad 8}$	$\overbrace{16 \quad 14}$	$\overbrace{31 \quad 29}$	$\overbrace{30 \quad 31}$	$\overbrace{36 \quad 34}$

The armature of cirrus IV is peculiar as illustrated by BROCH. Each of the median segments of the anterior ramus bears only a few small, erect spines scattered on the frontal face. On this point BROCH emphasized that this species holds the intermediate position between his *Eu-Acasta* group and *Inarmata* group of the genus. If we follow BROCH (1931) regarding the armature of the fourth cirri, the following species of *Acasta* may be regarded as a special section of his *Eu-Acasta* (or *Armata*) group. They are: *A. laevigata* GRAY, *A. semota* HIRO and the present *A. coriobasis* BROCH. As I (HIRO, 1937b, pp. 448-449) have already pointed out, however, such peculiar armature is often found also in some species of *Conopea*, a subgenus of *Balanus*, such as *B. cornutus*, *B. proripiens* (HOEK, 1913) and *B. granulatus* (HIRO, 1937b). Accordingly, these *Acasta*-species seem to represent the unique example indicating a close affinity with the group of *Conopea*, although they are in all essentials the member of the genus *Acasta*.

***Acasta alcyoncola* n. sp.**

(Fig. 2)

Locality. Kusimoto, Prov. Kii. Four specimens embedded in the barren stalk of *Capnella* sp. January 29, 1952, T. YAMAMOTO leg.

Ezura, Tanabe Bay, Prov. Kii. One specimen embedded in the barren stalk of *Nephthea* sp. April 30, 1951, T. YAMAMOTO leg.

So far as I am aware, only two species of *Acasta* are known living in alcyonaceans: One is *Acasta echinata* recorded from Tomioka, Kyusyu (HIRO, 1937a) and also from Condor Is., Indochina (BROCH, 1947), and the other is *A. sculpturata* recorded from Jave Sea (BROCH, 1931). The latter

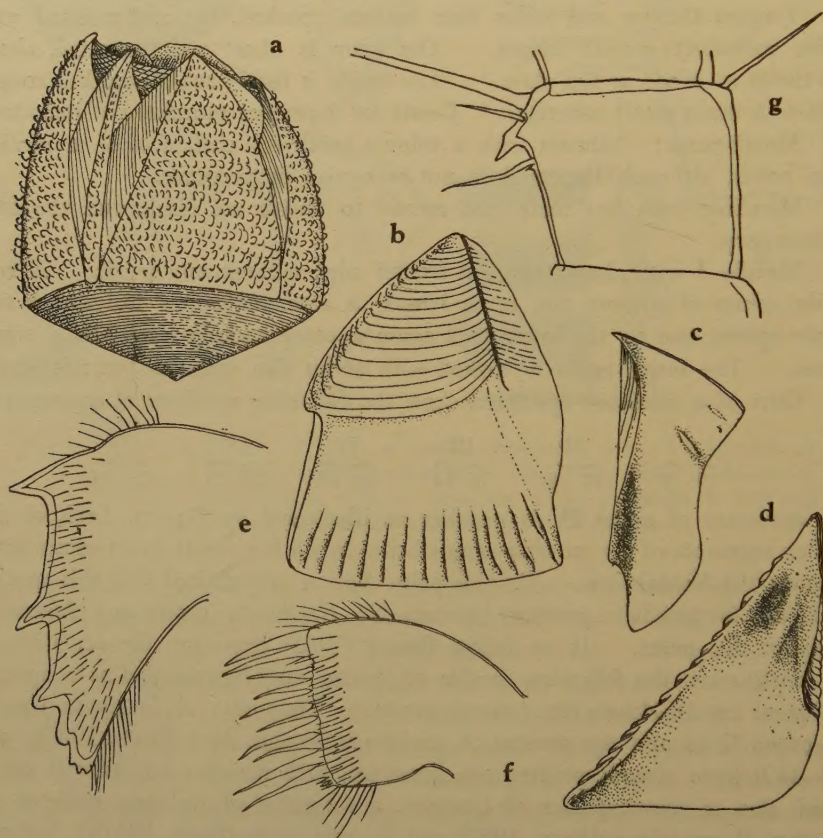


Fig. 2. *Acasta alcyoncola* n. sp. a type specimen. $\times 8$; b inner side of the lateral plate. $\times 10$; c inner side of tergum. $\times 10$; d inner side of scutum. $\times 10$; e mandible. $\times 65$; f maxilla I. $\times 65$; g lower segment of anterior ramus of cirrus IV. $\times 210$.

is, however, according to BROCH, found also in sponges as usual. As another example of the association I here add to the above list a new species of *Acasta*.

The present curious specimens are likewise found embedded in the tissue of the sterile stalk of Nephtheid alcyonarians, which are referred to both the genera *Capnella* and *Nephthea*. Their oblong splits on the surface of the alcyonarian colony are very small, so buried that they can only be detected with careful examination under the binocular microscope. It is impossible to dissect out intact specimens owing to the very intimate adherence to the tough alcyonarian tissues and the brittleness of shell plates.

The entire shell, when complete, is white, round like a globe, and the largest one measures about 9 mm in height and 6 mm in carinorostral diameter. The compartments are thin and solid, their surface provided with numerous short, flexible but mostly upturned, hairs which are very small and invisible to a naked eye; by these hairs the shell is in close contact with the extremely hard tissues of alcyonarians. On removal these hairs leave behind them only small round marks on the compartments but no pores.

The inside of the compartments below the sheath is smooth except for the lower half where distinct but short ribs are present; the basal edge of the sheath is not free from the inner face of the wall. Carinal latus is the narrowest of all compartments; in one specimen they measure in basal width: Carina 3 mm, carinal latus $1\frac{1}{2}$ mm, lateral 5 mm and rostrum 5 mm. The radii and alae are broad; the outer face of the radii is finely striated transversely and obliquely, while that of the alae not striated. The basal cup is rather shallow and saucer-shaped. It shows no trace of canaliculation nor special structure.

Scutum about as long as wide, rather flat externally and has an almost straight basal margin. The outside has prominent growth ridges crossed by slight radiating ridges. Inside there is a distinct pit for the adductor muscle at the upper position, where it corresponds to the middle of the articular ridge. The adductor ridge is also prominent but short, and separated by a triangular depression from the articular ridge, which is about half the height of the plate. The basitergal corner is rounded, without any indication of a pit for the depressor muscle.

Tergum nearly flat, somewhat beaked and slender with an almost straight scutal margin. The outer side exhibits the widely separated plain growth ridges and a shallow depression representing the spur furrow. The spur has a truncated end which is about half the width of the plate. The inside is almost smooth, but one or two faint indications of crests for the depressor muscles can hardly be traced.

Mouth-parts: Labrum with 2 or 3 tiny teeth on either side of a deep median notch.

Mandible with four main teeth and a bifid or trifid lower angle.

Maxilla I has a straight frontal edge with a faint indication of a notch between two large upper spines and a median row of six smaller spines, and on the lower part again two large spines followed by a few stiff spinules at its corner.

The number of segments of the cirri in a dissected specimen is as follows :

I	II	III	IV	V	VI
$\overbrace{20} \quad 7$	$\overbrace{12} \quad 8$	$\overbrace{14} \quad 13$	$\overbrace{18} \quad 20$	$\overbrace{25} \quad 25$	$\overbrace{27} \quad 27$

In cirrus I, the anterior ramus is a little longer than twice the posterior. Both of cirri II and III have the anterior ramus a little longer than the posterior. In cirrus IV, each segment of the anterior ramus bears two pairs of bristles, a hook and a rudimentary tiny spine on the basal segments only; such hooks or spines are lacking in the distal and median segments of the ramus.

Penis is long and finely annulated; no basi-dorsal process is present.

References

- BROCH, Hj. 1931 Indomalayan Cirripedia. Vidensk. Medd. Dansk naturh. Foren., Vol. 91. Odense.
 ——— 1947 Cirripedes from Indochinese Shallow-waters. Abhandl. Det Norske Vid.-Akad. Oslo, I. Mat.-Nat. Kl., 1947, No. 7, Oslo.
 HIRO, F. 1937a A New Barnacle, *Acasta echinata* n. sp. Imbedded in the Stalk of an Alcyonarian from Southern Japan. Zool. Mag. Tokyo, Vol. 49, No. 2. Tokyo.
 ——— 1937b Studies on Cirripedian Fauna of Japan. II. Cirripeds Found in the Vicinity of the Seto Marine Biological Laboratory. Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, Vol. 12, No. 3. Kyoto.
 HOEK, P. P. C. 1913 Cirripedia Sessilia. Siboga-Exped., Mon. 31b. Leiden.
 UTINOMI, H. 1949 Studies on the Cirripedia of Japan. I. Classification and Differentiation of Species. Seibutu, Vol. 4, No. 2. Sapporo. (In Japanese.)

Addendum

Recently I have found a large barnacle laid bare on a hard silicious sponge from off the cape Sio-no-misaki, collected by Mr. F. OGAWA. The specimen is of a rosy hue, about 9 mm in carinorostral diameter and 13 mm in height. The parietes are profusely spinose, with numerous sharp calcareous spines directed downward and the basal cup is shallow, saucer-shaped, 3 mm high. The opercular valves as well as the external features conform well with earlier descriptions of *Acasta cyathus* DARWIN which has hitherto been not recorded from Japan. Thus we can now note fourteen species of *Acasta* from the coastal waters of Japan proper.